Digitized by the Internet Archive
in 2010 with funding from
Natural History Magazine, Inc.

http://www.archive.org/details/naturalhistory91newy

NATURAL HISTORY

AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK, N.Y.

INDEX TO VOLUME 91, 1982

AUTHORS AND TITLES

A

Ahmadjian, V., *The Nature of Lichens*, Mar., p. 30
Altmann, J., *Mother Baboon*, Sept., p. 30
Anderson, J., *The Bountiful Yeoman*, Oct., p. 38
Asimov, I., *Numbers Large and Small*, Aug., p. 6

B

Bierzychudek, P., *Jack and Jill in the Pulpit*, Mar., p. 22
Boaz, N.T., *Fossils of the Libyan Sahara*, Aug., p. 34
Boltin, L., *The Natural History 1982 Calendar*, Jan., p. 43; *Foundry Art*, Jan., p. 67
Brown, L.R., *The Coming Solar Age*, Feb., p. 41
Burney, D.A., *Life on the Cheetah Circuit*, May, p. 50

C

Carlquist, S., *Hawaii: The First Arrivals*, Dec., p. 20
Carothers, S.W., *Dam Changes on the Colorado River*, Jan., p. 74
Carroll, G.F., *Born Again Seal*, July, p. 40
Carson, G., *Review*, Aug., p. 60
Carson, H.L., *Hawaii: An Introduction*, Dec., p. 16; *A Cloudy Future*, Dec., p. 72
Cartmill, M., *Review*, June, p. 60
Clague, D.A., *Hawaii: The Next Island*, Dec., p. 68
Clutton-Brock, T., *The Red Deer of Rhum*, Nov., p. 42
Cohen, M.L., *Review*, Apr., p. 58
Cook, R.E., *Attractions of the Flesh*, Jan., p. 20; *The Cold Facts of Winter Wheat*, Nov., p. 24
Cramer, D.L., *The Late, Great Sabertooths*, Apr., p. 50; *Fossils of the Libyan Sahara*, Aug., p. 34
Czerkas, S.M., *Giving Life to Ancient Bones*, Feb., p. 57

D

Dolan, R., *Dam Changes on the Colorado River*, Jan., p. 74

E

Eckholm, E., *Human Wants and Misused Lands*, June, p. 33
Edelson, E., *Review*, Jan., p. 100
Eldredge, N., *Review*, Feb., p. 78
Emerson, S., *The Late, Great Sabertooths*, Apr., p. 50
Englebert, V., *Reed People of Titicaca*, Jan., p. 34

F

Fitzpatrick, J.W., *Northern Birds at Home in the Tropics*, Sept., p. 40
Foott, J., *Squid Swarm*, Apr., p. 24
Ford, J.I., *Hawaii: Life Crawls Upstream*, Dec., p. 60
Fowles, J., *The Great Amateur of Archeology*, Aug., p. 18
Foxx, J.J., *From Child to Fisherman*, Mar., p. 44
Freed, S.A., *Review*, May, p. 27

G

Gerlach, L.P., *Review*, Nov., p. 30
Glut, D.F., *Giving Life to Ancient Bones*, Feb., p. 57
Gold, D.L., *Enchantment of the Fasnacht*, Feb., p. 28
González Grande, J.L., *A Forkful of Orioles*, Oct., p. 50
Gordon, R., *Journey to the Tibetan Plateau*, Sept., p. 48
Gould, S.J., *The Guano Ring*, Jan., p. 12; *Nonmoral Nature*, Feb., p. 19; *Moon, Mann, and Otto*, Mar., p. 4; *The Importance of Trifles*, Apr., p. 16; *Hutton's Purposeful View*, May, p. 6; *The Stinkstones of Oeningen*, June, p. 6; *The Oddball Human Male*, July, p. 14; *Free to Be Extinct*, Aug., p. 12; *Solitary Origins of Some Societies*, Sept., p. 6; *The Hottentot Venus*, Oct., p. 20; *Living with Connections*, Nov., p. 18; *Of Wasps and WASPs*, Dec., p. 8
Gradante, W., *Low and Slow, Mean and Clean*, Apr., p. 28
Groeschel, G., *Bird in a Cave*, Nov., p. 56
Groft, T.K., *Foundry Art*, Jan., p. 67

H

Haskins, C.P., *Review*, July, p. 70
Hiam, A.W., *Airborne Models and Flying Mimics*, Apr., p. 42
Horenstein, S., *Father Knickerbocker the First*, July, p. 74
Howell, T.R., *Desert-nesting Sea Gulls*, Aug., p. 52

J

Johnsgard, P.A., *Whooper Recount*, Feb., p. 70
Johnson, J., *Wild White Sheep*, Feb., p. 62
Jones, C., *The Lost and Lonely Birds of Mauritius*, Mar., p. 38
Jordan, W.H., Jr., *Invasion of the Medfly*, May, p. 70

K

Kaneshiro, K.Y., *Hawaii: The Flies Fan Out*, Dec., p. 54
Kastner, J., *Review*, Mar., p. 72
Kessler, D.J., *Junk in Space*, Mar., p. 12
Kinzie, R.A., III, *Hawaii: Life Crawls Upstream*, Dec., p. 60
Kirch, P.V., *Hawaii: Transported Landscapes*, Dec., p. 32
Kirshner, R.P., *Hole in Space*, Sept., p. 26
Knudtson, P.M., *Weavers of Wood*, May, p. 40
Kucera, T.E., *How Mule Deer Mate in Texas*, June, p. 50

L

Lanyon, W.E., *Fallow Field Guide to Birds*, May, p. 60
Luft, J., *Mother Baboon*, Sept., p. 30

M

MacMahon, J.A., *Mount St. Helens Revisited*, May, p. 14
Magoon, L., *The Making of Alaskan Oil Fields*, Oct., p. 8
Maran, S.P., *The Quasar Controversy Continues*, Jan., p. 85; *Quakes on the Moon*, Feb., p. 82; *The Inconstant Sun*, Apr., p. 62; *Where Do Comets Come From?* May, p. 80; *The Impossible Star*, June, p. 64; *Inside Jupiter's Rings*, Aug., p. 64; *Origin of the Crab Nebula*, Oct., p. 84; *Fall from Space*, Dec., p. 74
Martin, C.E., *Appalachian House Beautiful*, Feb., p. 4
Martin, R.D., *Et tu, Tree Shrew?* Aug., p. 26
Mendez, R.A., *Sealed in Amber*, June, p. 26; *Hawaii: The Flies Fan Out*, Dec., p. 54; *Hawaii: Life Crawls Upstream*, Dec., p. 60
Moore, J.G., *Hawaii: The Next Island*, Dec., p. 68
Moore, P.D., *Beneath the Blanket Bogs of Britain*, Nov., p. 48
Moore-Ede, M.C., *What Hath Night to Do With Sleep?* Sept., p. 22; *Sleeping As the World Turns*, Oct., p. 28

N

Neal, A., *Los Ambulantes*, Nov., p. 62
Nicholson, H.B., *Revelation of the Great Temple*, July, p. 48
Nicholson, T.D., *Celestial Events*, Jan., p. 94; Feb., p. 76; Mar., p. 82; Apr., p. 66; May, p. 84; June, p. 70; July, p. 66; Aug., p. 74; Sept., p. 68; Oct., p. 78; Nov., p. 38; Dec., p. 80
Normark, W.R., *Hawaii: The Next Island*, Dec., p. 68

O

Ohta, A.T., *Hawaii: The Flies Fan Out*, Dec., p. 54

P

Palmer, J.D., *Biorhythm Bunkum*, Oct., p. 90
Parker, A., *Los Ambulantes*, Nov., p. 62
Pasquier, R., *The Lost and Lonely Birds of Mauritius*, Mar., p. 38
Poinar, G.O., *Sealed in Amber*, June, p. 26

R

Radinsky, L., *The Late, Great Sabertooths*, Apr., p. 50
Ralph, C.J., *Hawaii: Birds of the Forest*, Dec., p. 40
Rensberger, B., *Review*, Sept., p. 74
Richstone, D., *Encounters of the Galactic Kind*, July, p. 60

S

Sax, J.L., *Free Enterprise in the Woods*, June, p. 14; *In Search of Past Harmony*, Aug., p. 42
Schell, O., *Journey to the Tibetan Plateau*, Sept., p. 48
Schildkrout, E., *From Child to Fisherman*, Mar., p. 44
Schreiber, R.W., *A Brown Study of the Brown Pelican*, Jan., p. 38
Shallenberger, R.J., *Hawaii: A Seal Slips Away*, Dec., p. 48
Sigurdsson, H., *In the Volcano*, Mar., p. 60
Simberloff, D., *Big Advantages of Small Refuges*, Apr., p. 6
Simon, C.A., *Masters of the Tongue Flick*, Sept., p. 58
Sokolov, R., *For Cuisine and Country*, Jan., p. 104; *Maryland Is for Crabs*, Feb., p. 90; *Heavy Date*, Mar., p. 86; *Southern Comfort*, Apr., p. 78; *Respect Your Elders*, May, p. 95; *Hooked*, June, p. 76; *Fish, Fresh from the Farm*, July, p. 76; *Quince Essentials*, Aug., p. 78; *Blue Notes*, Sept., p. 84; *L.A.'s Super Market*, Oct., p. 100; *To Market, to Market . . . to Buy a Tortilla*, Nov., p. 100; *A Garden of Earthy Delights*, Dec., p. 91
Spanfeller, J., *Human Wants and Misused Lands*, June, p. 33
Stein, D., *Mother Baboon*, Sept., p. 30
Stone, A., *A Home Computer Primer*, Nov., p. 84
Surrey, D.S., *"It's, Like, Good Training For Life,"* Nov., p. 70

T

Turnbull, C., *Bali's New Gods*, Jan., p. 26

U

Ukrain, D., *Bird in a Cave*, Nov., p. 56

V

Veit, P.G., *Gorilla Society*, Mar., p. 48
Vogelmann, H.W., *Catastrophe on Camels Hump*, Nov., p. 8

W

Waller, D.M., *Jewelweed's Sexual Skills*, May, p. 32
Ward, P.D., *Nautilus: Have Shell, Will Float*, Oct., p. 64
Waring, R.H., *Land of the Giant Conifers*, Oct., p. 54
Wetherill, G.W., *Dating Very Old Objects*, Sept., p. 14
Whitacre, D., *Bird in a Cave*, Nov., p. 56
Wuerthner, G., *Wild White Sheep*, Feb., p. 62

Z

Zimmermann, M.H., *Piping Water to the Treetops*, July, p. 6

SUBJECT MATTER

Acid rain, Nov., p. 8
AFRICA
  Baboons, Sept., p. 30
  Cheetah, May, p. 50
  Ghana, Mar., p. 44
  Gorillas, Mar., p. 48
  Hottentots, Oct., p. 20
Age dating, Sept., p. 14
Agriculture, New England, Oct., p. 38
ALASKA
  Oil fields, Oct., p. 8
  Wild sheep, Feb., p. 62
Algae on lichen, Mar., p. 30
Amber, June, p. 26
AMERICAN INDIANS
  Exhibit, Dec., p. 84
  Haida, May, p. 40
Americana, Appalachia, Feb., p. 4
ANTHROPOLOGY
  Appalachia, Feb., p. 4
  Bali, Jan., p. 26
  Electronics, Nov., p. 70
  Ewe people, Mar., p. 44
  Fanti people, Mar., p. 44
  Goloks, Sept., p. 48
  Haida Indians, May, p. 40
  Hottentots, Oct., p. 20
  Itinerant photographers, Nov., p. 62
  Maoris, Apr., p. 78
  Mexican-Americans, Apr., p. 28; Oct., p. 100; Nov., p. 100
  Polynesians, Dec., p. 32
  Switzerland, Fasnacht, Feb., p. 28
  Titicaca people, Jan., p. 34
  Tribal peoples, Third World, June, p. 38
  Uru Indians, Jan., p. 32
ARCHEOLOGY
  Aztec empire, July, p. 48
  John Aubrey, Aug., p. 18
Art, foundry, cast-iron stoves, Jan., p. 67
ASIA
  Tibet, Sept., p. 49
  Tree shrew, Aug., p. 26
ASTRONOMY
  Celestial Events, Jan., p. 94; Feb., p. 76; Mar., p. 82; Apr., p. 66; May, p. 84; June, p. 70; July, p. 66; Aug., p. 74; Sept., p. 68; Oct., p. 78; Nov., p. 38; Dec., p. 80
  Comets, May, p. 80
  Crab nebula, Oct., p. 84
  Debris in space, Mar., p. 12
  Galaxies, July, p. 60
  Jupiter rings, Aug., p. 64
  Meteorite, Nov., p. 94
  Moonquakes, Feb., p. 82
  Quasar, Jan., p. 85
  R 136a star, June, p. 64
  Satellite reentry, Dec., p. 74

  - Space holes, Sept., p. 26
  - Sun, Apr., p. 62
- At the American Museum, Jan., p. 88; Feb., p. 94; Mar., p. 78; Apr., p. 72; May, p. 88; June, p. 72; July, p. 74; Aug., p. 70; Sept., p. 80; Oct., p. 70; Nov., p. 94; Dec., p. 84
- Atacama Desert, Chile, Aug., p. 52
- Aztec empire, July, p. 48
- Baboons, Sept., p. 30
- Bali, Jan., p. 26
- Basketry, May, p. 40
- **BIOLOGY**
  - Lichen, Mar., p. 30
  - Plants, Jan., p. 20
  - Siamese twins, Nov., p. 18
- Biorhythms, Oct., p. 90
- **BIOS**
  - Plants, Jan., p. 20; Mar., p. 22
  - Winter wheat, Nov., p. 24
- **BIRDS**
  - Collections, Sept., p. 80
  - Dispersal agents, Dec., p. 20
  - Field guide, May, p. 60
  - Honeycreepers, Dec., p. 41
  - Migration, Sept., p. 40
  - Nests, Jan., p. 12; Sept., p. 80
  - of Mauritius, Mar., p. 38
  - Orioles, Oct., p. 50
  - Pelicans, Jan., p. 38
  - Sea gulls, Aug., p. 52
  - White-collared swifts, Nov., p. 56
  - Whooping cranes, Feb., p. 70
- Bogs, Nov., p. 48
- **BOTANY**
  - Conifers, Oct., p. 54
  - Dates, Mar., p. 86
  - Elder shrub, May, p. 95
  - Hawaii, Dec., p. 20; p. 36
  - Jewelweed, May, p. 32
  - Lichen, Mar., p. 30
  - Plants, Jan., p. 20; Mar., p. 22
  - Quince, Aug., p. 78
  - Sequoia, May, p. 88
  - Trees, May, p. 88; July, p. 6; Nov., p. 8
  - Winter wheat, Nov., p. 24
- **BRITAIN**
  - Scotland, Nov., p. 42
  - Wetlands, Nov., p. 48
- British Columbia, Canada, May, p. 40
- Brown pelican, Jan., p. 38
- Butterflies, Apr., p. 42
- **CALIFORNIA**
  - Dates, Mar., p. 86
  - Medfly, May, p. 70
  - Mexican-Americans, Apr., p. 28; Oct., p. 100; Nov., p. 100
  - Seals, July, p. 40
  - Sequoia, Mark Twain, May, p. 88
  - Squid, Apr., p. 24
  - Supermarkets, Oct., p. 100; Nov., p. 100
- Caribbean volcano, Mar., p. 60
- Cars, low riders, Apr., p. 28
- Catfish, July, p. 76
- Caves and white-collared swifts, Nov., p. 56
- Celestial Events *see* Astronomy
- Champions of American Sport, Mar., p. 78
- Cheese, blue, Sept., p. 84
- Cheetah, May, p. 50
- Chile, Aug., p. 52
- Circadian timing system, Sept., p. 22; Oct., p. 28
- Climate, June, p. 33; Nov., p. 48
- Clocks, internal, Sept., p. 22; Oct., p. 28
- Comets, theory of, May, p. 80
- Computers, Nov., p. 84
- Conifers, Oct., p. 54
- **CONSERVATION**
  - Hawaii, Dec., p. 72
  - Mauritius Island, Mar., p. 38
- Crab nebula, Oct., p. 84
- Crabs, Feb., p. 90
- Cranes, whooping, Feb., p. 70
- Crops for energy, Feb., p. 45
- Cuvier, Georges, June, p. 6
- Dall's sheep, Feb., p. 62
- Darwin, Feb., p. 19; Apr., p. 16
- Dates, Mar., p. 86
- DDT and brown pelicans, Jan., p. 38
- Debris in space, Mar., p. 12
- Deer, June, p. 50; Nov., p. 42
- Desert, June, p. 45; Aug., p. 34; Aug., p. 52
- Dinosaurs, Jan., p. 88; Feb., p. 57
- **ECOLOGY**
  - Birds, May, p. 60; Sept., p. 40
  - Deer, red, Nov., p. 42
  - Forests, Oct., p. 54
  - Gorillas, Mar., p. 48
  - Grand Canyon, Jan., p. 74
  - Hawaii, Dec., pp. 41, 54, 60
  - Mauritius Island, Mar., p. 38
  - Mount St. Helens, May, p. 14
  - Squid, Apr., p. 24
  - Third World, June, p. 33
  - Wildlife refuge, Apr., p. 6
  - Winter wheat, Nov., p. 24
- Ecosystems, Hawaii, Dec., pp. 32, 72
- Elderberry, May, p. 95
- Electronics, Nov., p. 70, p. 84
- Elephant seals, July, p. 40
- **ENDANGERED SPECIES**
  - Birds on Mauritius, Mar., p. 38
  - Brown pelicans, Jan., p. 38
  - Cranes, Feb., p. 70
  - Forest birds, Hawaii, Dec., p. 40
  - Monk seals, Dec., p. 48
- **ENERGY**
  - Crops, Feb., p. 45
  - Renewable, Feb., p. 56
  - Solar, Feb., pp. 52, 53, 55
  - Waste, Feb., p. 44
  - Water, Feb., p. 47
  - Wind, Feb., p. 48
  - Windmills, geothermal, Feb., p. 50
  - Wood, Feb., p. 42
- **ENVIRONMENT**
  - Birds, Sept., p. 40
  - Forests, Oct., p. 54
  - Goloks, Sept., p. 48
  - Grand Canyon, Jan., p. 74
  - Hawaii, Dec., pp. 36, 54, 72
  - Mule deer, June, p. 50
  - Third World, June, p. 33
- Ethnohistory, Hawaii, Dec., p. 32
- **EVOLUTION**
  - Hawaii, Dec., pp. 16, 68
  - Sabertooths, Apr., p. 50
  - Theory of evolution, Feb., p. 19; July, p. 14; Sept., p. 6
- Ewe people, Mar., p. 44
- Extinction of species, Aug., p. 12
- Fanti people, Mar., p. 44
- Festivals, Fasnacht, Feb., p. 28
- Film festival, Oct., p. 70
- **FISHES**
  - Catfish, July, p. 76
  - Fishing, June, p. 76
- Flies, drosophilid, Dec., p. 54
- **FOOD**
  - Blue cheese, Sept., p. 84
  - Catfish, July, p. 76
  - Crabs, Feb., p. 90
  - Dates, Mar., p. 86
  - Elderberry, May, p. 95
  - Fishing, June, p. 76
  - Gardening, vegetables and fruits, Dec., p. 91
  - Preservation, Oct., p. 38
  - Quince, Aug., p. 78
  - Regional cookery, Jan., p. 104
  - Steamed, New Zealand, Apr., p. 78
  - Supermarkets, Oct., p. 100; Nov., p. 100
  - Tortilla, Nov., p. 100
- **FORESTRY**
  - National parks, June, p. 14
  - Trees, July, p. 6
- **FORESTS**
  - and acid rain, Nov., p. 8
  - Birds, Hawaii, Dec., p. 40
  - Ecosystems, Oct., p. 54
- **FOSSIL**
  - Bone, July, p. 74
  - Dinosaurs, Jan., p. 88; Feb., p. 57
  - Insects and amber, June, p. 26
  - Libyan Sahara, Aug., p. 34
- France, parks, Aug., p. 42
- Freshwater streams, Hawaii, Dec., p. 60
- Fruit fly, May, p. 70
- Fuels *see* Energy
- Fungi on lichen, Mar., p. 30
- Galaxies, July, p. 60
- Gardening, vegetables and fruits, Dec., p. 91
- **GEOLOGY**
  - Amber, June, p. 26
  - Dating, radioactive, Sept., p. 14
  - Fossil bone, July, p. 74
  - Museum's stones, Aug., p. 70
  - Grand Canyon, Jan., p. 74
  - James Hutton, father of, May, p. 6
  - Libyan Sahara, Aug., p. 34
  - Mount St. Helens, May, p. 14
  - Mount St. Vincent, Mar., p. 60
  - Petroleum, Oct., p. 8
  - Stinkstone slate, June, p. 6
  - Volcano, Mar., p. 60; May, p. 14; underwater, Dec., p. 68
- Geothermal heat, Feb., p. 50
- Glen Canyon Dam, Jan., p. 74
- Golok tribesmen, Sept., p. 48
- Gorillas, Mar., p. 48
- Grand Canyon, Jan., p. 74
- Great Temple, Aztec, July, p. 48
- Guano ring, bird nests, Jan., p. 12
- Haida Indians, May, p. 40
- Haleakala National Park, Dec., p. 37
- Hawaii, Dec., pp. 16, 20, 32, 36, 40, 48, 54, 60, 68, 72
- **HISTORY**
  - of Park Service, June, p. 14
  - of science, Feb., p. 19; May, p. 6; June, p. 6; July, p. 14; Aug., pp. 6, 12; Sept., p. 6; Oct., p. 20; Nov., p. 18
- Honeycreepers, Hawaiian, Dec., p. 40
- Hottentot Venus, Oct., p. 20
- Hutton, James, May, p. 6

- INSECTS
  - Butterflies, Apr., p. 42
  - Flies, Dec., p. 54
  - Fossil, June, p. 26
  - Medfly, May, p. 70
- Internal clock, Sept., p. 22; Oct., p. 28
- INVERTEBRATES
  - Crabs, Feb., p. 90
  - Nautilus, Oct., p. 64
  - Squid, Apr., p. 24
- Jack-in-the-pulpit, Mar., p. 22
- Jewelweed, May, p. 32
- Jupiter rings, Aug., p. 64
- Kenya, East Africa, Sept., p. 30
- Knight, C.R., Feb., p. 57
- Libyan Sahara, Aug., p. 34
- Lichens, Mar., p. 30
- Lizards, Apr., p. 72; Sept., p. 58
- Males and females, July, p. 14
- MAMMALS
  - Baboons, Sept., p. 30
  - Cheetahs, May, p. 50
  - Gorillas, Mar., p. 48
  - Monk seals, Dec., p. 48
  - Mule deer, June, p. 51
  - Red deer, Nov., p. 42
  - Seals, July, p. 40; Dec., p. 48
  - Tree shrews, Aug., p. 26
  - White wild sheep, Feb., p. 62
- Maoris, New Zealand, Apr., p. 78
- Marine mammals, July, p. 40; Dec., p. 48
- Mathematics, Aug., p. 6
- MATTER OF TASTE
  - Cheese, Sept., p. 84
  - Crabs, Feb., p. 90
  - Dates, Mar., p. 86
  - Elderberries, May, p. 95
  - Fish, July, p. 76
  - Fishing, June, p. 76
  - Gardening, Dec., p. 91
  - Quince, Aug., p. 78
  - Regional cookery, Jan., p. 104
  - Steamed food, Apr., p. 78
  - Supermarket, Oct., p. 100
  - Tortilla, Nov., p. 100
- Mauritius Island, Indian Ocean, Mar., p. 38
- Medfly, May, p. 70
- Mediterranean fruit fly, May, p. 70
- Meteorite, Ellis Hughes, Nov., p. 94
- Mexican-Americans, Apr., p. 28; Oct., p. 100; Nov., p. 100
- Mexico, July, p. 48; Nov., p. 56
- Mineral, amber, June, p. 26
- Monk seal, Hawaiian, Dec., p. 48
- Moonquakes, Feb., p. 82
- Mount St. Helens, May, p. 14
- Mount St. Vincent, Mar., p. 60
- Mountain gorillas, Mar., p. 48
- Mule deer, June, p. 50
- NASA satellite, June, p. 64
- NATIONAL PARKS
  - and free enterprise, June, p. 14
  - Haleakala, Dec., p. 36
- NATURALIST AT LARGE
  - Biorhythms, Oct., p. 90
- Naturemax theater, Feb., p. 94
- Nautilus, Oct., p. 64
- New Zealand, Apr., p. 78
- NORTH AMERICA
  - Birds, Sept., p. 40
  - Elderberries, May, p. 95
  - Forests and acid rain, Nov., p. 8
- Numbers, Aug., p. 6
- Oil fields, Alaska, Oct., p. 8
- Oort cloud, May, p. 80
- Orioles, Oct., p. 50
- Pacific Northwest forests, Oct., p. 54
- PALEONTOLOGY
  - Fossils, July, p. 74; Aug., p. 34
  - Stinkstones, June, p. 6
- Pelicans, brown, Jan., p. 38
- Peru, Jan., p. 34
- Photographic competition, winners, July, p. 24
- PHYSIOLOGY
  - Biological rhythms, Oct., p. 90
  - Sleep, Sept., p. 22; Oct., p. 28
- Planets, Jupiter, Aug., p. 64
- PLANTS
  - Dates, Mar., p. 86
  - Dispersal of, Jan., p. 20
  - Elder shrub, May, p. 95
  - Jack-in-the-pulpit, Mar., p. 22
  - Jewelweed, May, p. 32
  - Lichens, Mar., p. 30
- Polynesians, settlement of Hawaii, Dec., p. 32
- Prehistoric animals, sabertooths, Apr., p. 50
- Prehistoric people, Nov., p. 48
- Quasar, Jan., p. 85
- Quince, Aug., p. 78
- Redwoods, Oct., p. 54
- Regional cookery, Jan., p. 104
- Renewable energy, Feb., p. 56
- Reptiles, lizards, Apr., p. 72; Sept., p. 58
- Rocks, dating of, Sept., p. 14
- R136a star, June, p. 64
- Sabertooths, Apr., p. 50
- Satellite reentry, Dec., p. 74
- Sea gulls, Aug., p. 52
- Seals, July, p. 40; Dec., p. 48
- Sequoia, May, p. 88
- Seton, E.T., June, p. 72
- Sexual behavior, Dec., p. 8
- Sheep, wild, Feb., p. 62
- Siamese twins, Nov., p. 18
- Silverswords, Hawaiian, Dec., p. 36
- Sky Reporter *see* Astronomy
- Sleep, timing and duration, Sept., p. 22; Oct., p. 28
- SOLAR ENERGY
  - Feb., pp. 41, 52, 53, 55; Apr., p. 62
- SOUTH AMERICA
  - Birds, Sept., p. 40; Nov., p. 56
  - Titicaca people, Jan., p. 34
- Space holes, Sept., p. 26
- Space missions, Mar., p. 12
- Squid, Apr., p. 24
- Star R136a, June, p. 64
- Stinkstone slate, June, p. 6
- Stoves, cast-iron, Jan., p. 67
- Sun, Apr., p. 62
- Supermarkets, Oct., p. 100; Nov., p. 100
- Supernova, Oct., p. 84
- Swifts, white-collared, Nov., p. 56
- Switzerland, Fasnacht, Feb., p. 28
- TECHNOLOGY
  - Computers, Nov., p. 84
  - Video games, Nov., p. 70
- Theory of natural selection, July, p. 14
- THIRD WORLD
  - Deserts, June, p. 45
  - Ecology, June, p. 33
  - Tribal peoples, June, p. 38
  - Undernutrition, June, p. 35
- THIS VIEW OF LIFE
  - Birds, Jan., p. 12
  - Evolution, Feb., p. 19; Sept., p. 6
  - Extinction of species, Aug., p. 12
  - Geology, May, p. 6
  - Hottentot Venus, Oct., p. 20
  - Males and females, July, p. 14
  - Scopes trial II, Mar., p. 4
  - Sexual behavior, Dec., p. 8
  - Siamese twins, Nov., p. 18
  - Stinkstone slate, June, p. 6
  - Worms and scientific reasoning, Apr., p. 16
- Tibet, Sept., p. 48
- TIME
  - Clocks, biological, Sept., p. 22; Oct., p. 28
  - Dating, radioactive, Sept., p. 14
- Titicaca people, Jan., p. 34
- Tortilla, Nov., p. 100
- TOURIST AS PILGRIM
  - Bali, Jan., p. 26
- TREES
  - and acid rain, Nov., p. 8
  - Conifers, Oct., p. 54
  - Hydraulic architecture of, July, p. 6
  - Sequoia, Mark Twain, May, p. 88
- Tree shrews, Aug., p. 26
- Tribal peoples, Third World, June, p. 38
- Undernutrition, Third World, June, p. 35
- United Nations, Stockholm conference, June, p. 33
- Uru Indians, Jan., p. 32
- VERTEBRATE PALEONTOLOGY
  - Dinosaurs, Jan., p. 88; Feb., p. 57
  - Sabertooths, Apr., p. 50
- Video games, Pac-Man, Nov., p. 70
- VOLCANOES
  - Mount St. Helens, May, p. 14
  - Mount St. Vincent, Mar., p. 60
  - Underwater, Hawaii, Dec., p. 68
- Waste products, conversion of, Feb., p. 44
- Water, Feb., p. 47
- West Africa, Ghana, Mar., p. 44
- Wetlands, Nov., p. 48
- Wheat, winter, Nov., p. 24
- Whooping cranes, Feb., p. 70
- Wildlife refuge, Apr., p. 6
- Wind, harnessing of, Feb., p. 48
- Wood as fuel, Feb., p. 42
- Yeomen, New England, Oct., p. 38
- BOOKS IN REVIEW
  - *Elephants*, Sept., p. 74
  - *Endangered Sex, The*, May, p. 27
  - *Evolution: Genesis and Revelations*, June, p. 60
  - *Extraordinary Landscape, The*, Oct., p. 74
  - *Growth of Biological Thought, The*, July, p. 70
  - *Looking Far North: The Harriman Expedition to Alaska 1899*, Aug., p. 60
  - *New Evolutionary Timetable, The*, Feb., p. 78
  - *Out of China's Earth*, Apr., p. 58
  - *Progress and Privilege*, Nov., p. 30
  - *To the Ends of the Earth*, Mar., p. 72
- Television Show in Review, *Life on Earth*, produced by the BBC, Jan., p. 100

NATURAL HISTORY

$2

1/82

© 1981 VOLKSWAGEN OF AMERICA

How the Rabbit works: The Diesel.

Nothing else is a Volkswagen.

Oil is a natural liquid energy-storage system. It is produced by burying undecomposed organic matter under hundreds of tons of pressure for 200 million years. Prudence dictates that we use it sparingly.

Which is the fundamental advantage of Dr. Rudolph Diesel's compression ignition engine.

The engine can have all the air it wants, but only enough fuel to accomplish the job at hand. At idle, that can be as low as 4 tablespoons an hour. Although very efficient, it is also very slow and heavy.

To address these disadvantages, VW introduced the lightest 4-cylinder Diesel ever produced. A wider power band and substantially improved performance were provided by a new swirl-chamber, aluminum cylinder head.

If all you want is to be prudent, all Diesels should be of passing interest. If you're interested in passing too, there is only one choice.

The Rabbit Diesel. Also known as the best mileage car in America.*

*EPA estimated $\boxed{45}$ mpg 58 highway estimate. (Use "Estimated mpg" for comparisons. Your mileage may vary with weather, speed, and trip length. Actual highway mileage will probably be less.)

The 1982 **Natural History** *Magazine Photographic Competition*
... See page 16

NATURAL HISTORY

Vol. 91, No. 1, January 1982

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director

6 Authors

12 This View of Life *Stephen Jay Gould*
The Guano Ring

20 Bios *Robert E. Cook*
Attractions of the Flesh

26 The Tourist as Pilgrim *Colin Turnbull*
Bali's New Gods

34 Reed People of Titicaca *photographs by Victor Englebert*
In the highlands of Peru, a group of Indians live on floating man-made islands.

38 A Brown Study of the Brown Pelican *Ralph W. Schreiber*
These birds, now back from the edge of extinction, are sensitive indicators of marine pollution.

43 The Natural History 1982 Calendar *photographs by Lee Boltin*
Please pull this bonus from the middle of the magazine and enjoy it on your desk or wall during the year.

67 Foundry Art *Tammis Kane Groft, photographs by Lee Boltin*
A fuel shortage early in the nineteenth century spurred the development of ornate and efficient cast-iron stoves.

74 Dam Changes on the Colorado River *Steven W. Carothers and Robert Dolan*
Some flora and fauna have begun to adjust to the profound changes of habitat caused by the Glen Canyon Dam.

85 Sky Reporter *Stephen P. Maran*
The Quasar Controversy Continues

88 At the American Museum
Sternberg and the Dinosaur Mummy

92 Additional Reading

94 Celestial Events *Thomas D. Nicholson*

100 Review *Edward Edelson*
Science in Installments

104 A Matter of Taste *Raymond Sokolov*
For Cuisine and Country

Cover: *The brown pelican has overcome the ravages of DDT contamination but still faces an uncertain future. Photograph by John J. Bangma, Photo Researchers. Story on page 38.*

Alan Ternes, Editor
Judith Friedman, Managing Editor
Thomas Page, Designer
Board of Editors: Carol Breslin,
Sally Lindsay, Frederick Hartmann,
Vittorio Maestro, Rebecca B. Finnell
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
E. Kay Danzig, Art Asst.
Kay Zakariasen, Picture Editor
Lauren Krenzel, Photo Research
Douglas J. Preston, Publications Editor
Annie R.C. Finch, Editorial Asst.
Lillian Berger
Editorial Advisers:
Malcolm Arth, James W. Atz,
Niles Eldredge, Kenneth L. Franklin,
E.Craig Morris, Norman Newell,
Thomas D. Nicholson, Martin Prinz,
Gerard Piel, Nina Root

David D. Ryus, Publisher
Bradford D. Smith, Business Manager
Frederick E. Grossman, Production Mgr.
Debra Buck McCord, Asst. Production Mgr.
Ernestine Weindorf, Administrative Asst.
Elaine M. Callender, Advtg. Production Mgr.

Cary Castle, Circulation Manager
Jeff Pieper, Assoc. Circulation Mgr.
Ramón E. Alvarez, Asst. Circulation Mgr.
Frank Stevens, Circulation Asst.

NATURAL HISTORY *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024.*
Subscriptions: $15.00 a year. In Canada and all other countries: $18.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.

Copyright © 1981 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.*

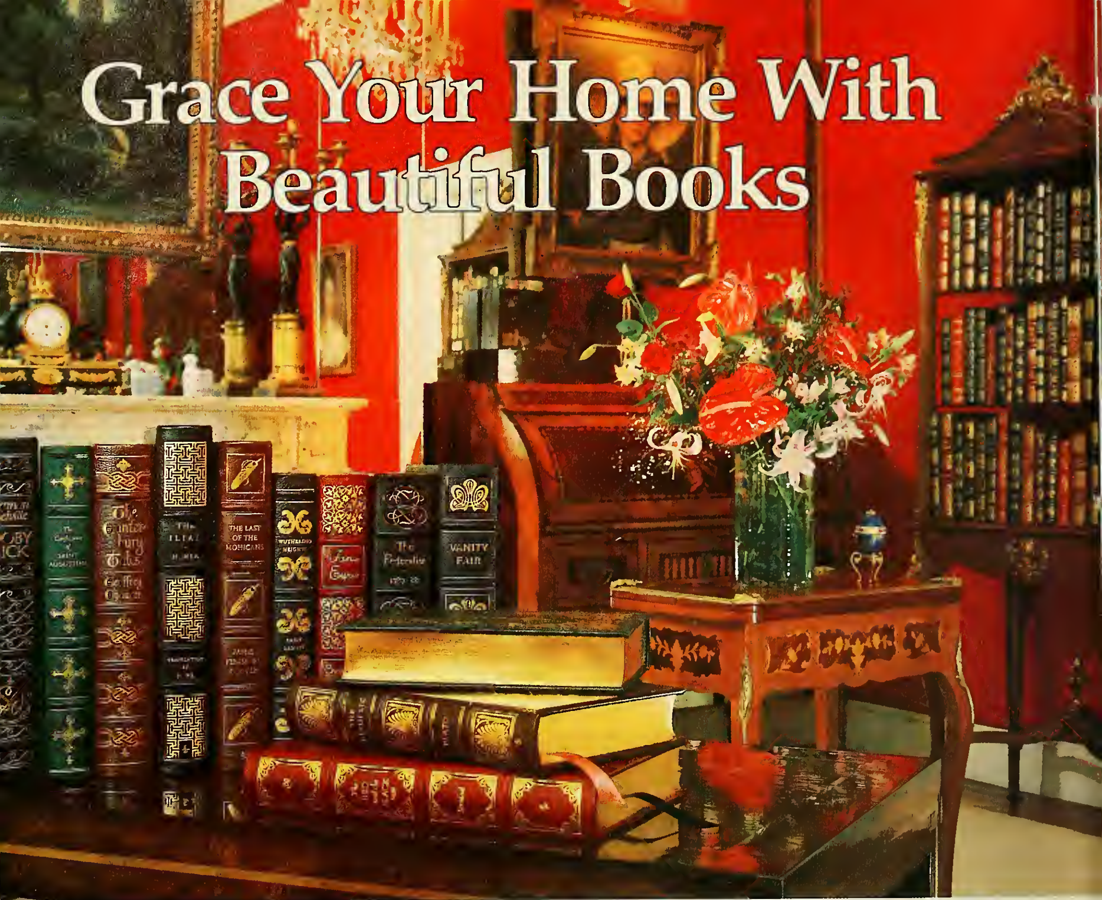
Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225
Subscription Orders (800) 247-5470
(800) 532-1272 (in Iowa)

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

Grace Your Home With Beautiful Books


THE LAST OF THE MOHICANS
The Federalist
VANITY FAIR

You can now acquire for your home the ultimate collection of the world's great classics,

The 100 Greatest Books Ever Written

Bound in genuine leather and accented with real gold.

Like fine furniture and original art, beautiful books have long been among the esteemed treasures of fine homes. For generations, discerning men and women have especially sought leather-bound editions of the great classics...for their worth as literature and for their incomparable beauty in the home. Today such books are not easily acquired. Yet, with this announcement, readers of Natural History are invited to own "The 100 Greatest Books Ever Written" in one of the most beautiful leather-bound editions ever published.

Beautiful books lend grace to every home. Whatever the setting, fine leather-bound books impart an aura of distinction and evoke a feeling of substance. They are elegant in and of themselves; they bring importance to their surroundings.

And, for those so fortunate to acquire such books, there is the sheer joy of possession. For these are things of beauty that enrich our lives and exalt our senses. Like a treasured antique, a delicate print, a favorite work of porcelain... each beautiful book is personally prized and lovingly owned. Indeed, for those acquainted with beautiful books, it is difficult to imagine one's home without them.

Like fine art, these volumes will be treasured always.

Books are treasured not just for their beauty. That, too—but also for their content. Consider the titles chosen for this incomparable collection—books which have been recognized as outstanding for decades or centuries. The greatest novels the world has ever known—among them, Melville's *Moby Dick*, Dickens' *A Tale of Two Cities*, and Cervantes' *Don Quixote*. Works of serious thought, such as Plato's *Republic*. Heroic epics: Homer's *Iliad* and Virgil's *Aeneid*. Sharp-witted satire, such as Swift's *Gulliver's Travels*. Works of beauty, including Whitman's *Leaves of Grass*.

Here are the titans of literature. Shakespeare, Chaucer, Milton, Dante, Dumas, and Dostoevsky. Tolstoy and Turgenev. Our own beloved Mark Twain. James Joyce. Henry James. Here are books that educate, uplift, instruct, and inspire—books you can enjoy for a lifetime and bequeath to future generations.

Every book
fully bound
in genuine leather

Genuine full-leather bindings.

It is becoming more and more difficult to find books bound entirely in genuine leather. Some publishers produce volumes with only spines covered in leather, the rest of the binding covered with cloth. These simply cannot compare in beauty with full-leather bindings. So please note: **Every book in this collection will be fully bound in genuine leather.**

Intricate cover designs accented with real 22kt gold.

Each luxurious full-leather binding will be deeply inlaid with real gold on the spine and in perfectly matched golden designs on the front and back covers. Then, to bring out the full beauty of each cover design, the pages will be gilded along all three sides with a special golden finish.

Centuries-old traditions of fine book craftsmanship.

In accordance with centuries-old customs, each book will be bound with a raised or "hubbed" spine—both for added beauty, and durability. The endsheets will be of elegant moiré fabric, and each volume will have its own permanently sewn ribbon page marker. The paper for each volume will be specially milled to last for generations.

(Continued on next page)

A TALE OF TWO CITIES
Gulliver's Travels
THE SEA-WOLF
THE JUNGLE BOOKS
UNCLE TOM'S CABIN
The MILL on the FLOSS
The Scarlet Letter
VANITY FAIR
LORD JIM

"Hubbed" spines in the classic tradition of the bookbinders art

Handsome, readable type faces individually selected for each volume

Distinctive cover designs accented with real 22kt gold

Highest-quality, acid-neutral paper will last for generations without turning yellow

Beautiful illustrations capture the essence of each author's work

Gilded page edges provide elegance and protection from dust and moisture

Permanently sewn ribbon page marker

Endsheets of rich moiré fabric

BOOKS
Gulliver's Travels by Jonathan Swift

Exciting diversity.

Each book will have its own unique cover design, created by a master book designer, to lend individuality to the volume. The sizes of the books will vary, as will their colors—with each book perfectly proportioned for beauty, balance, and harmony with the rest of the collection.

Magnificent illustrations.

Each volume will be illustrated in a manner which matches the mood and the meaning of the author's work. In many cases, authentic illustrations from the period of the literary masterpiece will be used. In other instances, leading illustrators have been commissioned to create original works of art expressly for this collection.

Available only by Advance Subscription.

Subscriptions to The Easton Press edition of "The 100 Greatest Books Ever Written" are being offered on an advance registration basis. This means that only subscribers to the collection can acquire this private library of distinction. The books will never be made available to bookstores or rare book galleries.

Comparable books bound in genuine leather command as much as $75.00 per volume. However, you will be pleased to learn that the volumes in this collection will be priced at just $35.00 each for the first two full years. Future volumes will be similarly priced, subject only to minor periodic adjustment to reflect varying material costs.

Convenient Acquisition Plan.

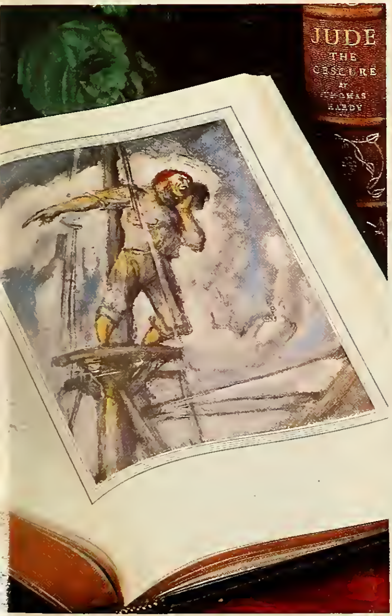
Because of the extraordinary care and craftsmanship required in printing and binding, the books will be issued one per month. This is of great benefit to you, because you may pay at the convenient rate of one volume per month, and you have a full month to enjoy each volume before the next one arrives.

As a subscriber, you will never receive any books you do not want. A list of the 100 books scheduled in the collection will be sent to you. You may indicate which titles on the list, if any, you do not wish to receive, insuring that you acquire only the books you wish to own. If you desire, you may return any volume within 30 days for a full refund of your purchase price. Moreover, you need purchase volumes only as long as you choose to do so; you may cancel your subscription at any time.

To accept this invitation, simply complete the Preferred Subscription Reservation at the right and return it today. It is not necessary to send any payment now. This simple step is all that's needed for you to begin building a private library that is certain to become a mark of distinction in your home.

(Continued from previous page)

LORD JIM
JOSEPH CONRAD
THE THREE MUSKETEERS
DUMAS
Fathers & Sons
by Ivan Turgenev
The RED and the BLACK
Stendhal
The Arabian Nights
The Scarlet Letter
Hawthorne
MADAME BOVARY
GUSTAVE FLAUBERT
The Way of All Flesh
BUTLER


JUDE THE OBSCURE
BY THOMAS HARDY

Preferred Subscription Reservation 629

The 100 Greatest Books Ever Written

The Easton Press
47 Richards Avenue
Norwalk, Conn. 06857

No payment required.
Simply mail this
Subscription reservation.

Please send me the first volume of "The 100 Greatest Books Ever Written" bound in genuine leather and reserve a subscription in my name. Further volumes will be sent at the rate of one book per month at \$35.00* each. This price will be guaranteed for the next two full years.

A list of books scheduled for future monthly shipment will be sent to me. I may indicate which titles on this list, if any, I do not want to receive, thereby insuring that I never receive any books I do not want. I understand that I may return any book within 30 days for a refund, and that either party may cancel this subscription agreement at any time.

*Plus \$2.50 per book for shipping and handling.

Payment Options (Check One):

☐ Charge each volume to my:
☐ MasterCard ☐ VISA

Credit Card No. ____________

Expiration Date ____________

☐ Enclosed is \$37.50** (payable to Easton Press) for my first volume.

☐ Bill me \$37.50** prior to shipment for my first volume..

Name ____________

Address ____________

City ____________

State ____________ Zip ____________

Signature ____________

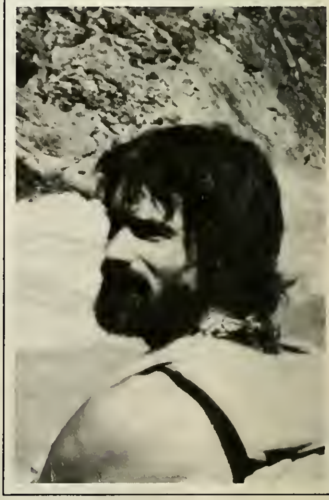
**Connecticut residents pay \$40.32 to include sales tax.

Authors

With pelicans on his mind since 1968, **Ralph W. Schreiber** has spent considerable time studying their behavior, biology, and taxonomy. He has been particularly concerned with the brown pelican, a species that had been in danger of extinction in the United States because of the effects of DDT contamination. For the past five years, Schreiber has served as curator of ornithology at the Natural History Museum of Los Angeles County. In what little time he has between overseeing the museum's bird collection and learning all he can about pelicans, he photographs birds.

Folklorist **Tammis Kane Groft** was unaware of the elegance and variety of cast-iron stoves until she was hired by the Albany Institute of History and Art as a consultant to prepare a show and write a catalog entitled *Cast with Style: Nineteenth Century Cast-Iron Stoves from the Albany Area.* After traveling throughout the northeast countryside photographing Albany and Troy stoves in the attics, basements, and barns of avid stove collectors, she found herself thoroughly hooked. As a curator at the Albany Institute, Groft is in charge of the extensive collection of modern art selected during the 1960s to complement the Governor Nelson A. Rockefeller Empire State Plaza, New York State's new governmental center.

"As a lad of three," Arizona-born **Steven W. Carothers** reports, "I was led (attached to a dog leash) into the Grand Canyon by my parents. Since then, it has always been my favorite place. Until very recently, I spent in excess of a hundred days each year working on research projects and sleeping under the protective mantle of the Grand Canyon sky." Carothers has been a research associate with the Museum of Northern Arizona for fifteen years. His interests range from the ecology of river systems in the Southwest to feral burros and their influence on western rangelands. A river runner himself, he also studies the ecological considerations of float trips and other forms of river recreation.



Coauthor **Robert Dolan** is a professor in the Department of Environmental Sciences at the University of Virginia. In 1973, while working as a consulting geologist for the National Park Service, he began studying the changes that have taken place in the Colorado River and Grand Canyon following the construction of Glen Canyon Dam in the early 1960s. A canoeist and fisherman, Dolan has made at least one two-week float trip through the Grand Canyon every year since that time. His present research includes a continuation of his Colorado River work, with particular emphasis on sedimentary processes within the canyon. Closer to home, Dolan studies barrier islands off the Atlantic Coast.

Q. What is the new WEBSTER'S DELUXE UNABRIDGED DICTIONARY about?

WEBSTER'S DELUXE UNABRIDGED DICTIONARY

~~Pub. at $69.95~~
Your Price $19.95

A. It's about 2,300 pages and more than 4 inches thick!

For more than 40 years Webster's Unabridged Dictionary has served as an invaluable reference for students, teachers, businessmen, secretaries. . . and workers in all trades and professions. The reason is simple. Here is a dictionary that fills the need for accurate and full definitions, correct spellings and pronunciations, full etymologies, synonyms, as well as other general and specific information.

A large staff of lexicographers and linguists has painstakingly edited and updated each definition so that it is clear, accurate, and readily understood in all its senses. Many new entries have been added, including recent additions to the language in the natural and social sciences, the humanities and other specialized branches of human knowledge.

un a bridġed′, *a.* not shortened; complete; specifically, designating a dictionary that has not been abridged from a larger work.
un·aç·cent′ed, *a.* not accented; specifically, in

The large, clear, legible type shown above (actual size) "makes this unabridged dictionary the most readable one in print."

. . . now own one of the finest reference books in the world at less than ⅓ of its originally published price.

NEW DELUXE COLOR EDITION

Includes Thousands of Illustrations Along With Full-Color Maps of the World

Plus it contains these important supplements!

1. A Dictionary of Biography
2. A Dictionary of Geography
3. A Dictionary of Noted Names in Fiction, Mythology, Legend
4. A Dictionary of Foreign Words and Phrases
5. A Dictionary of Scripture Proper Names and Foreign Words
6. Abbreviations Commonly Used in Writing and Printing
7. Practical Business Mathematics
8. Forms of Address
9. Tables of Weights and Measures
10. Special Signs and Symbols
11. Presidents of the United States
12. Vice Presidents and Cabinet Officers of the United States
13. Declaration of Independence
14. Constitution of the United States
15. History of Canada
16. Charter of the United Nations
17. Air Distances between Principal Cities
18. Principal Geographic Features of the World
19. Commercial and Financial Terms

BARNES & NOBLE / SALE ANNEX

SAVE $50

126 FIFTH AVENUE DEPT. WD 617
NEW YORK, N.Y. 10011

PUBLISHED AT $69.95
NOW ONLY $19.95

Please rush me____*Webster's Deluxe Unabridged Dictionary* at your special sale price of $19.95 (plus $3.00 postage and insurance). N.Y. and N.J. Residents Add Sales Tax.

Mr. ☐ Ms. ☐
NAME (Please print clearly)
ADDRESS
CITY ZIP

FOR FASTER SERVICE
CREDIT CARD CUSTOMERS
CALL TOLL FREE 1-800-228-2057 / EXT. 15
Lines are open 24 HOURS
7 DAYS A WEEK . . . including Sundays
In Nebraska call 402-571-4900
Offer good only in the continental U S A
© 1981, BARNES & NOBLE BOOKSTORES, INC

THE BARNES & NOBLE MAIL ORDER GUARANTEE

Every book you purchase from Barnes & Noble by mail must meet your standards. If not... return it for a full refund within 30 days or credit to your charge account.

In business for 105 years, Barnes & Noble has become "the world's largest bookstore." (See the current Guinness Book of World Records.) Our goal is to sell the finest books in the world at the lowest possible prices. Ask about us at your local school or public library

I prefer to charge this purchase: ✓Check One

American Express Card ☐ VISA ☐ Master Card ☐ 4 digits above your name

Account# Exp.
Signature 0262709

ROYAL WORCESTER

ROYAL DOULTON

ZSOLNAY

VERBANO

WEDGWOOD

HAVILAND

MOSA

FRANKLIN

HUTSCHENREUTHER

COALPORT

KAISER

FINE BONE CHINA
CROWN
ESTD 1801
STAFFORDSHIRE
ENGLAND
Orchard Glory
R
HAND CRAFTED

The back of each plate will bear the world-famous mark of its maker.

SUBSCRIPTION APPLICATION

Miniature Plates of
The World's Great Porcelain Houses

The Franklin Mint
Franklin Center, Pennsylvania 19091

Please enter my subscription to *Miniature Plates of The World's Great Porcelain Houses,* consisting of 25 finely crafted miniature plates, to be sent to me at the rate of one plate per month.

I need send no money now. Please bill me $19.50* for each miniature plate in advance of shipment. A hardwood étagère will be provided at no additional cost.

**Plus my state sales tax and $1 for shipping and handling*

Signature ____________________

ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE.

Valid only if postmarked by January 31, 1982.

Limit: One collection per subscriber.

Mr.
Mrs.
Miss ____________________
PLEASE PRINT CLEARLY

Address____________________

City____________________

State, Zip____________________

© 1981 FM

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BO

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO 1 FRANKLIN CENTER, PENNSYLVANIA

POSTAGE WILL BE PAID BY ADDRESSEE

THE FRANKLIN MINT
Franklin Center, Pennsylvania 19063

For the first time ever . . . a collection of 25 miniature plates – each one different – each designed and produced by one of the world's most famous porcelain houses.

Miniature Plates of The World's Great Porcelain Houses

A handsome hardwood étagère, specially designed to display the complete collection, will be provided to each subscriber at no added charge.

Available by subscription only, and only from The Franklin Mint
Limit of one collection per subscriber.

The great porcelain houses of the world: Wedgwood and Royal Doulton of England. Royal Copenhagen of Denmark. Haviland of France. Hutschenreuther of Germany. Lladró of Spain. Noritake of Japan. Ginori of Italy. Each is represented in this unprecedented collection by an original miniature plate created by that great porcelain house solely for this series.

Never before in the history of plate collecting have the world's leading porcelain houses participated in the creation of such a collection. A unique and intriguing collection representing the art of the world's greatest porcelain houses.

Each miniature plate is different from every other in pattern and design. There are also variations in shape, in size, in texture, in type of glaze and decoration. For each plate embodies the distinctive spirit, theme or traditional style of its maker.

Yet in spite of these differences, all are elegant, all are beautiful, all are worthy representatives in miniature of the great porcelain houses that created them.

Impossible to assemble in any other way

Assembling this collection has been a formidable challenge. It took four years of meticulous planning and preparation by The Franklin Mint to make this collection possible. Years during which the representatives of the mint traveled all over the world to secure the cooperation of the leading porcelain houses of the world and to persuade each maker to participate in this unprecedented international issue.

Even if you traveled around the world yourself and visited each porcelain house personally, you could not duplicate this series. For each miniature plate is being designed and produced *exclusively* for this collection.

Each miniature plate reflects the pride of its maker

Since each plate in this collection represents one of the great porcelain houses of the world, it is being designed and produced by that house's master artists and craftsmen to the highest standards of perfection. And since each reflects the pride of a great porcelain house, every miniature plate will bear upon its reverse the name and identifying mark of its maker.

Together, the plates will form a most gracious and harmonious collection. A collection so beautiful, so fascinating and so rich in the most glorious traditions of fine porcelain that it is certain to be treasured and prized throughout the years to come.

The subscription plan

This unique collection is available *only* from The Franklin Mint, *only* by subscription, and there is also a limit of one collection per subscriber. The plates will not be made available separately, nor will they be sold in any retail stores.

As a subscriber, you will receive your collection at the rate of one miniature plate each month, at the original issue price of $19.50 per plate. And this price will be *guaranteed* to each subscriber, even though the plates must be purchased by The Franklin Mint in many different foreign currencies over the next two years. In view of world-wide inflationary trends and currency fluctuations, this is a highly significant guarantee.

Mail your application by January 31, 1982

Because it will take considerable time for each porcelain house to craft its miniature plate, and because each house has many other commitments, the subscription application below should be mailed to The Franklin Mint, Franklin Center, Pa. 19091, no later than January 31, 1982.

SUBSCRIPTION APPLICATION

MINIATURE PLATES OF
THE WORLD'S
GREAT PORCELAIN HOUSES

Valid only if postmarked by January 31, 1982.
Limit: One collection per subscriber.

The Franklin Mint
Franklin Center, Pennsylvania 19091

Please enter my subscription to *Miniature Plates of The World's Great Porcelain Houses*, consisting of 25 finely crafted miniature plates, to be sent to me at the rate of one plate per month.

I need send no money now. Please bill me $19.50* for each miniature plate in advance of shipment. A hardwood étagère will be provided at no additional cost.

**Plus my state sales tax and $1 for shipping and handling*

Signature ____________
ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE

Mr.
Mrs.
Miss ____________
PLEASE PRINT CLEARLY

Address ____________

City ____________

State, Zip ____________

38

Plates shown much smaller than actual size (3" diameter average).

© 1982 FM

The Guano Ring

Whether a booby chick is inside or outside a circle of excrement becomes a matter of life and death

by Stephen Jay Gould

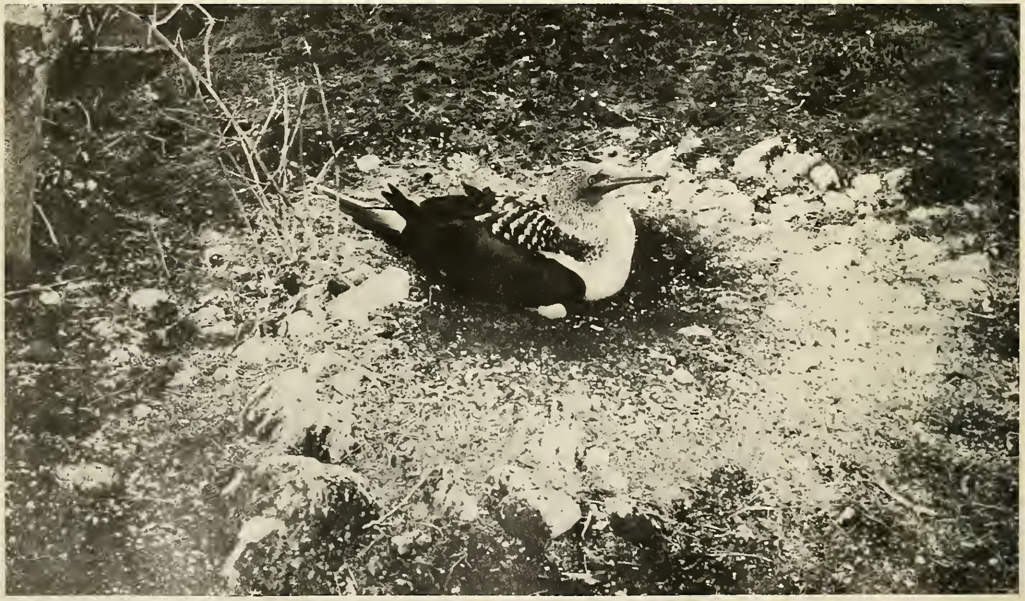
When I first went to sea as a petrified urbanite who had never ridden anything larger than a rowboat, an old sailor (and Navy man) told me that I could chart my way through this *aqua incognita* if I remembered but one simple rule for life and work aboard a ship: if it moves, salute it; if it doesn't move, paint it.

If we analyze why such a statement counts as a joke (albeit a feeble one) in our culture, we must cite the incongruity of placing such a "mindless" model for making decisions inside a human skull. After all, the essence of human intelligence is creative flexibility, our skill in grasping new and complex contexts—in short, our ability to make (as we call them) judgments, rather than to act by the dictates of rigid, preset rules. We are, as Konrad Lorenz has stated, "specialists in nonspecialization." We do not behave as machines with simple yes-no switches, invariably triggered by definite bits of information present in our immediate environments. Our enlightened sailor, no matter how successful at combating rust or avoiding the brig, is not following a human style of intelligence.

Yet this inflexible model does represent the style of intelligence followed with great success by most other animals. The decisions of animals are usually unambiguous yeses or noes triggered by definite signals, not subtle choices based upon the assessment of a complex gestalt.

Many birds, for example, do not recognize their own young and act instead according to the rule: care for what is inside the nest; ignore what is outside. British ethologist W. H. Thorpe writes: "Most birds, while they may be very attentive to their young in the nest, are completely callous and unresponsive to those same young when, as a result of some accident, they are outside the nest or the immediate nest territory."

This rule rarely poses evolutionary dilemmas for birds, since the objects in their nests are usually their own young (carrying their Darwinian heritage of shared genes). But this inflexible style of intelligence can be exploited and commandeered to a nefarious purpose by other species. Cuckoos, for example, lay their eggs in the nests of other birds. A cuckoo hatchling, usually larger and more vigorous than the rightful inhabitants, often expels its legitimate nest



On North Seymour Island in the Galápagos, a blue-footed booby sits inside the guano ring that marks its nest. D.M. Porter

High yield is just one reason for choosing the EQUITABLE Money Market Account.

Today, with your money under constant pressure to provide and perform, it's essential that you make it work as hard for you as it can. Today, with the economy still so uncertain, it's advisable not to tie up your money for long periods of time, but rather to keep it flexible…fluid…*available*.

The Equitable Money Market Account is an excellent place to put your money to work *until you need it*. We urge you to consider all of the many advantages of the Equitable Money Market Account before you make another investment decision:

1. **Enjoy higher earnings.** The Equitable Money Market Account provides a convenient way for you to get the higher rates currently available in the money market.
2. **Participate in a low-risk portfolio** of prime, short-term money market instruments, many of which are securities insured or guaranteed by the U.S. government or issued by billion-dollar banks or corporations with very high credit ratings.
3. **Open an account easily**—with as little as $2,500. And add $100 or more any time you wish. And, you can do it quickly and simply—all by mail.
4. **Withdraw your money at any time, without charge.**
5. **You'll have check-writing privileges** for immediate access to your money. We'll send you free, personalized checks to use in amounts of $500 or more.
6. **Your earnings will accrue for you daily** and compound every month as long as they remain in your account. Or if you prefer, you can have your cash dividends sent to you every month.

For more information and a Prospectus, return this coupon or call EMMA toll free:

800-345-8540.

In Pennsylvania, call 1-800-662-5180. Call any time—7 days a week, 24 hours a day.

The EQUITABLE Money Market Account
EQUICO Securities, Inc.
3 Westchester Plaza
Elmsford, NY 10523

YES, I want more complete information on the Equitable Money Market Account, Inc., including management fees and expenses. Please send me a Prospectus so that I may read it carefully before I invest or send money. 783

Name________________________
(Please print)

Address________________________

City________________________

State____________ Zip____________

Telephone________________________
(area code) (number)

A money market fund distributed by EQUICO Securities, Inc., a wholly owned subsidiary of The Equitable Life Assurance Society of the United States, the Account's Investment Adviser.

This offering may not yet be available in some states.

EQUITABLE

THE EQUITABLE MONEY MARKET ACCOUNT

Advised by The EQUITABLE Life, with over 120 years of investment experience.

Better Than Jogging

NordicTrack

Jarless Total Body Cardiovascular Exerciser

Duplicates X-C Skiing for the Best Motion in Fitness

Highly Effective and Pleasant To Use
The enjoyable sport of cross-country skiing is often cited as the most perfect form of cardiovascular exercise for both men and women. Its smooth, fluid, total body motion uniformly exercises more muscles and higher heart rates seem easier to attain than when jogging or cycling. NordicTrack closely simulates the same pleasant motion and provides the same cardiovascular endurance-building benefits — right in the convenience of your home. Makes a year round, consistent exercise program easily attainable. Eliminates the usual barriers of time, weather, chance of injury, etc. Also highly effective for weight control.

Better Than Running
NordicTrack gives you a more complete work out — conditions both upper body and lower body muscles at the same time. Fluid, jarless motion will not cause joint or back pains as jogging or running often does.

Better Than Exercise Bikes
NordicTracks stand-up skiing motion more uniformly exercises large leg muscles and also adds important upper body exercise. Higher pulse rates, necessary for building fitness, seem easier to attain because the work is shared by more muscle mass. The NordicTrack also keeps more muscles in tone.

Even Better Than Swimming
NordicTrack more effectively exercises the largest muscles in the body, those located in the legs and buttocks. These muscles main function is to lift and propel the body in the standing position. When swimming, the water supports the body thus preventing these muscles from being exercised as effectively as when they support the body in a standing position as when using the NordicTrack.

A Proven, high Quality Durable Product
Ruggedly constructed, NordicTrack is quiet, motorless and folds compactly for storage. Separate arm and leg resistances. NordicTrack is in its 5th year of production and is used in thousands of homes and many companies. We manufacture and sell direct. Our No-Risk 15 day trial guarantee shows our confidence in your being pleased with the performance and quality of the NordicTrack.

For more information, call or write
PSI 124 L Columbia ct. Chaska, MN 55318
toll free 1-800-328-5888 8 - 5 Mon - Fri
Minnesota 612-448-6987

mates, which will die, frantically begging for food, when their parents follow the rule, ignore them for their inappropriate location, and feed the young cuckoo instead. We can intellectualize our anthropomorphism away, but we cannot expunge it from our aesthetic reactions. I must confess that no scene of organic activity makes me angrier about the world's injustice than the sight of a foster parent, its own young killed by a cuckoo, solicitously feeding a begging parasite that may be up to five times its own size (for cuckoos may choose much smaller birds as their hosts, and the fledglings are often much larger than the foster parents).

This summer, while in the Galápagos Islands, I encountered another, and interestingly different, example of birds that exploit this common rule, twisting it to different uses. But this time, both the victim and benefactor are true siblings and the end result, although condemning weaker siblings to death, is evolutionary advantage for family lines.

The boobies (along with their cousins, the gannets) form a small (nine species) but widespread family of seabirds, the Sulidae. (Everything, and more, that you will ever want to know about sulids you will find in J. Bryan Nelson's magnificent monograph: *The Sulidae: Gannets and Boobies*, 1978.) Earliest references in the Oxford English Dictionary indicate that boobies received their unflattering name, not for the distinctive waddling walk of one major display, big feet out and head held high in a behavior called "sky pointing," but for their remarkable tameness, which allowed sailors (bent only on destruction) to catch them so easily.

Three species of sulids inhabit the Galápagos Islands: the red-footed, the blue-footed, and the masked booby. The red-footed booby lays a single egg in a conventional nest built near the tops and edges of trees and bushes. By contrast, its cousin of markedly different natural pedicure, the blue-footed booby, lays its eggs on the ground and builds no true nest at all. Instead, it delimits the nesting area in a remarkable and efficient way: it squirts guano (bird excrement to nonornithologists who have not read *Doctor No*) in all directions around itself, thus producing a symmetrical white ring as a symbolic marker of its nest.

Within this ring, the female blue-foot lays, not one (as in many boobies), but from one to three eggs. In his most impressive discovery, Nelson has explained much about the breeding behavior and general ecology of boobies by linking the production of eggs and young to the quality and style of feeding in parents. Boobies such as the red-foot, which travel long distances (up to 300 miles) to locate scarce sources of food, tend to lay but a single large egg, hatching into a resilient chick that can survive long intervals between parental feedings. On the other hand, when food sources are rich, dependable, and near shore, more eggs are laid and more young reared. At the extreme of this tendency lies the Peruvian booby, with its clutch of two to four eggs (averaging three) and its ability to raise all chicks to adulthood. Peruvian boobies feed on the teeming anchovies of their local waters, fish that may be almost as densely packed in the ocean as in the sardine cans that may become their posthumous home.

The blue-foot lies between these two tendencies. It is a nearshore feeder, but its sources have neither the richness nor the predictability of swarming anchovies. Consequently, conditions vary drastically from generation to generation. The blue-foot has therefore evolved a flexible strategy based on the exploitation by older siblings of their parents' intellectual style: yes-no decisions triggered by simple signals. In good times, parents may lay up to three eggs and successfully fledge all three chicks; in poor years, they may still lay two or three eggs and hatch all their chicks, but only one can survive. The death of nest (or, rather, ring) mates is not the haphazard result of a losing struggle to feed all chicks with insufficient food but a highly systematic affair based on indirect murder by the oldest sibling.

I was reminded of the quip about painting and saluting while observing blue-footed boobies on Hood Island in the Galápagos. Their guano rings cover the volcanic surface in many places, often blocking the narrow paths that visitors must tread in these islands. Parents sit on their eggs and young chicks, apparently oblivious to groups of visitors who gawk, gesticulate, and point cameras within inches of their territory. Yet I noticed, at first by accident, that any intrusion into a guano ring would alter the behavior of adult birds—from blissful ignorance to directed aggression. A single toe across the ring elicited an immediate barrage of squawking, posturing, and pecking. A few casual experiments led me to the tentative conclusion that the boundary is an invisible circle right in the middle of the ring. I could cautiously advance my toe across the outer boundary with no effect; but as I

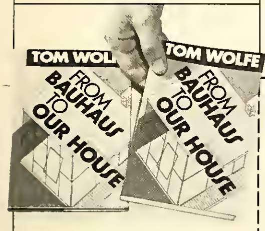
QPB SURVIVAL KIT

QPB members will take the 80's in stride with the best and most helpful books on money, energy, environment, do-it-yourself. And, of course, other important works of fiction and nonfiction.

QPB books are softcover editions in hardcover sizes, durably bound and printed on fine paper. But they cost up to 65% less than their hardcover counterparts.

Save money. Survive the 80's. Join QPB.

Compare



Hardcover:	**QPB Softcover:**
$10.95	**$5.95**

532. From Bauhaus to Our House Tom Wolfe
Hardcover: $10.95 **QPB Ed: $5.95**

198. The Essential Darkroom Book Tom Grill and Mark Scanlon
Hardcover: $17.95 **QPB Ed: $10.50**

459. The Next Whole Earth Catalog: Access to Tools. (Second Edition) Edited by Stewart Brand
QPB: $12.80

462. Mathematical Magic Show and Mathematical Circus. (2 Vols.) Martin Gardner
Hardcover: $18.90 **QPB: $7.90**

465. Taking the Quantum Leap The New Physics for Nonscientists. Fred Alan Wolf. **QPB: $7.95**

472. Special Effects in the Movies How They Do It. John Culhane
QPB: $8.50

464. Whitney's Star Finder A Field Guide to the Heavens. (Third Edition) **QPB: $7.95**

596. The Solar Age Resource Book Editors of 'Solar Age' magazine
QPB: $7.95

632. Dover Logic Books: *Puzzles in Math and Logic,* Aaron J. Friedland; *My Best Puzzles in Logic and Reasoning,* Hubert Phillips ("Caliban"); *Test Your Logic,* George J. Summers; *Recreations in Logic,* D.G. Wells. (4 Vols.)
QPB: $7.50

389. Sex in History. Reay Tannahill
Hardcover: $17.95 **QPB: $7.95**

397. The Unabridged Mark Twain, Vol. I. Edited by Lawrence Teacher
QPB: $8.95

114. The Unabridged Mark Twain, Vol. II. Edited by Lawrence Teacher
QPB: $8.95

121. Gödel, Escher, Bach An Eternal Golden Braid. Douglas R. Hofstadter. **QPB: $7.95**

351. The American Medical Association's Handbook of First Aid and Emergency Care Developed by the American Medical Association. **QPB: $4.95**

454. Brewer's Dictionary of Phrase & Fable. Centenary Edition, Revised. Edited by Ivor H. Evans
Hardcover: $25.95 **QPB Ed: $12.95**

Let's try each other for 6 months.

Quality Paperback Book Club, Inc., Middletown, Pa. 17057.
Please enroll me in QPB and send the 3 choices I've listed below. Bill me $3, plus shipping and handling charges. I understand that I am not required to buy another book. You will send me QPB *Review* (if my account is in good standing) for 6 months. If I have not bought and paid for at least 1 book in every six-month period, you may cancel my membership. A shipping and handling charge is added to each shipment. QB 113-1

Indicate by number the 3 books or sets you want ☐ ☐ ☐

Name________________________ 2-16
(Please print clearly)

Address____________________ **Apt.**______

City__________ **State**______ **Zip**______

How membership works.
1. You receive **QPB Review** 15 times each year (about every 3½ weeks). Each issue reviews a new **Main Selection,** plus scores of Alternates. QPB books are softcover editions in hardcover sizes, but they cost up to 65% less.
2. If you want the **Main Selection** do nothing. It will be shipped to you automatically. If you want one or more Alternate books—or no book at all—indicate your decision on the Reply Form always enclosed and return it by the date specified.
3. **Bonus books for Bonus Points.** For each QPB book or set you take (except for the books in this offer), you earn Bonus Points which entitle you to choose any of our softcover books. You pay only shipping and handling charges.
4. **Return privilege.** If *QPB Review* is delayed and you receive the **Main Selection** without having had 10 days to notify us, you may return it for credit at our expense.
5. **Cancellations.** You may cancel membership at any time by notifying QPB. We may cancel your membership if you elect not to buy and pay for at least one book in every six-month period.

Prices generally higher in Canada.

367. Johnny Blackwell's Poor Man's Catalog
Hardcover: $14.95 **QPB: $4.95**

381. The New York Times Book of Wine. Terry Robards
Hardcover: $14.95 **QPB: $5.95**

386. Rapid Viz: A New Method for the Rapid Visualization of Ideas. Kurt Hanks and Larry Belliston
QPB: $6.50

112. Inversions: A Catalog of Calligraphic Cartwheels. Scott Kim
QPB: $7.95

108. Build Your Own Furniture Peter Stamberg. **QPB: $7.95**

111. The Search for Alexander An Exhibition. Contributions by Nicholas Yalouris, Manolis Andronikos, and Katerina Rhomiopoulou. (Photographs)
Hardcover: $24.95 **QPB: $9.95**

Join now. Pick any 3 books or sets for $1 each – with no obligation to buy another book.

126. The Arbor House Treasury of Modern Science Fiction Compiled by Robert Silverberg and Martin H. Greenberg
Hardcover: $19.95 **QPB: $7.95**

149. Peter the Great His Life and World. Robert K. Massie
Hardcover: $19.95 **QPB: $7.95**

151. The Lord of the Rings (3 Vols., Boxed) J.R.R. Tolkien
Hardcover: $35.95 **QPB: $9.95**

163. Conceptual Blockbusting A Guide to Better Ideas. (Second Edition) James L. Adams
Hardcover: $10.95 **QPB: $3.95**

430. Going to Extremes Joe McGinniss
Hardcover: $11.95 **QPB: $6.95**

447. Myths of Greece and Rome Thomas Bulfinch. Compiled by Bryan Holme. **QPB: $8.95**

284. The Last Laugh. S. J. Perelman
Hardcover: $12.95 **QPB Ed: $6.95**

327. Riddley Walker. Russell Hoban
Hardcover: $12.95 **QPB Ed: $6.95**

398. The Dinosaurs. Illustrated by William Stout, Edited by Byron Preiss, Introduction by Dr. Peter Dodson
QPB: $10.95

432. Celebrations of Life René Dubos
Hardcover: $12.95 **QPB Ed: $6.95**

116. Information Please Almanac Atlas and Yearbook 1982.
Hardcover: $9.95 **QPB: $4.95**

542. How to Be Your Own Doctor (Sometimes). (Revised and Updated Edition) Keith W. Sehnert, M.D., with Howard Eisenberg. **QPB: $6.95**

257. The Comet Is Coming! The Feverish Legacy of Mr. Halley. Nigel Calder
Hardcover: $12.95 **QPB Ed: $7.50**

QPB **The first book club for smart people who aren't rich.**

The 1982 NATURAL HISTORY Photographic Competition Is Open for Entries

The Grand Prize for the 1982 Natural History Photographic Competition will be an eleven-day trip to the Galápagos Islands, the volcanic archipelago that lies in the Pacific Ocean 600 miles off the coast of Ecuador. The prize, worth more than $2,500, includes airfare from New York, a stay in highland Ecuador, and a berth on the yacht *Buccaneer*. A living laboratory for the study of natural history, the Galápagos Islands are renowned for the influence they had on Charles Darwin and the development of evolutionary theory. The islands' exotic birds and reptiles—many unique to the area—are remarkably tame; our Grand Prize-winner can look forward to a rare opportunity to record wildlife at close range. Three Museum scientists will introduce the biological and geological features encountered during this American Museum of Natural History Discovery Tour.

First Prizes of $500 each will be awarded in the contest's five categories: Animals (including birds and bugs); Plants and Their Environment; The Human Family; A Sequence in Nature (up to five photographs); and Humor in Nature. Ten Honorable Mentions of $100 will be selected from all entries.

In addition, the designer and the editor of *Natural History* will choose a special $500 Cover Photograph Award for the July 1982 issue. Strong design, wide appeal, vertical format, and space for the magazine's logo will be among the points considered for this award.

The winning entries will be published in the July issue of *Natural History* and exhibited at the American Museum of Natural History. All winners will receive certificates of their awards, suitable for framing.

THE RULES

1. The competition is open to everyone except employees of the American Museum and their kin.

2. You may submit a total of up to five entries, in any combination of the categories (a sequence is considered a single entry). The photographs must have been taken by you and not have been published before.

3. The Museum acquires the right to publish, exhibit, and use for promotion the winning photographs. The Museum assumes no responsibility for entries.

4. Entries may be transparencies or prints, either color or black-and-white, up to 8 by 10 inches. Each must bear the photographer's name and address. Entries must *not* be mounted in glass.

5. Please enclose the official entry form (or a 3- by 5-inch facsimile), with your name, address, phone number, and total number of photographs submitted.

6. A self-addressed, stamped envelope must accompany your entries for them to be returned.

7. Entries must be postmarked no later than April 1, 1982.

Pack them carefully and mail them to:

Natural History Photographic Competition
11 West 77th Street
New York, New York 10024

And good luck!

The 1982 *Natural History*
Photographic Competition
—Official Entry—

Name ______________________
Address ______________________
____
____
Phone ( )

For office use

Logged in:
____
date initials

Returned:
____
date initials

List all photographs entered, including each item in a sequence:
number: ______transparencies
number: ______prints
total: ______

moved it forward, as slowly and as unobtrusively as possible, I invariably passed a central point that brought on the pronounced parental reaction all at once.

Three hours later, I learned from our excellent guides and from Bryan Nelson's popular book (*Galápagos: Islands of Birds*, 1968) how older siblings exploit this parental behavior. And, anthropomorphic as we all must be, it sent a shiver of wonder and disgust up my spine. (Science, to a large extent, consists of enhancing the first reaction and suppressing the second.) The female blue-foot lays her eggs several days apart, and they hatch in the same order. The firstborn sibling is thus larger and considerably stronger than its one or two ring mates. When food is abundant, parents feed all chicks adequately and the firstborn does not molest its younger siblings. But when food is scarce and only one chick can survive, the actions of younger sibs evoke (how, we do not know) a different behavior by big sister or brother. The oldest simply pushes its younger siblings outside the guano ring. As human mammals, our first reaction might be: so what? The younger sibs are not physically hurt and they end up but a few inches from the ring, where parents will surely notice their plaintive sounds and struggling motions and gather them quickly back.

But a parental booby does no such thing, for it operates like our proverbial sailor who made an either-or judgment by invoking the single criterion of movement. Parental boobies must work by the rule: if a chick is inside the ring, care for it; if it is outside, ignore it. Even if the chick should flop, by happenstance, upon the ring, it will be rejected with all the vehemence applied to my transgressing foot.

We saw a chick on Hood Island struggling just a foot outside the ring in plain sight of the parent within, sitting (in an attitude that we tend to read as maternal affection) upon the triumphant older sibling (which did not, however, seem to be smirking). Every mother's son and daughter among us longed to replace the small chick, but a belief in noninterference must be respected even when it hurts. For if we understand this system aright, such a slaughter of the innocents is a hecatomb for success of the lineages practicing it. Older chicks only expel their siblings when food cannot be secured to raise them all. A parental struggle to raise three on food for one would probably lead to the death of all.

The rule of "nurture within, ignore or reject outside" cannot represent all the complexity of social behavior in nesting boobies. After all, most birds are noted "egalitarians" in their division of labor between sexes, and male boobies spend almost as much time incubating eggs and chicks as do the females. Since these stints last on the order of a day or so, boobies must permit their mates to transgress the sanctity of the guano ring when exchanging roles of care and provision. Still, the basic rule remains in force; it is not flouted but rather overridden by specific and recognized signals that act as a ticket of admission. K.E.L. Simmons, working on Ascension Island with the related brown booby (a species that does not inhabit the Galápagos), described the extensive series of calls and landing rituals that returning mates use to gain admission to their territory. But when adults trespass upon the unattended territory of an unrelated bird (as they often do to scrounge nest material on the cheap), they enter as "silently and as inconspicuously as possible."

If chicks could perform the overriding behaviors, they too could win readmission to the ring. Indeed, they learn these signals as they age, as well they must, for older chicks begin to wander from the ring as they gain sufficient

"HE PERCHED MOTIONLESS.
I HELD MY BREATH AND REACHED
FOR MY NIKONS...
NIKON 9X30
ROOF PRISM
BINOCULARS

...And suddenly it was as though I was next to him. I could make out every detail with incredible clarity and brilliance; the moist eyes, each feather stood out in startling detail. It was a moment I would never forget. I was glad I chose Nikons."

It's moments like these that make you glad you didn't settle for anything less than Nikon Binoculars. Their superb optics and uncompromising prism-lock construction are designed to give years of flawless performance even under the toughest conditions.

There are more than 20 Nikon Binoculars to choose from. See them at your Nikon dealer or write Nikon Inc., Dept. 26, 623 Stewart Ave., Garden City, N.Y. 11530.

Nikon

©1981 NIKON INC

INDIA.
WHERE THE
WORD IS WORTH
A THOUSAND
PICTURES.

Visit the Taj.

Our people are warm and friendly

Make a houseboat your hotel

Stay in a modern hotel

Live in a Maharajah's lake palace

Ancient temples.

Peacocks roosting in mango trees.

Colorful bazaars bustling with people.

India will fill your life with pictures. Pictures that will last forever.

In India you can trek on rugged mountain trails, do yoga on a fabulous beach, meet holy men.

You can stay in great hotels, or float in your own houseboat.

Whatever you'd like, we have. Wildlife. Art, music and dance. Enchanting festivals and fairs.

And more.

Come visit us. There are lots of tours to our country. Your travel agent will tell you about them. Or send us the coupon and we will.

UNBELIEVABLE
INDIA

Please send me information on Unbelievable India. NH1

Name

Address

City, State, Zip

GOVERNMENT OF INDIA TOURIST OFFICE
30 ROCKEFELLER PLAZA, NEW YORK, N.Y. 10112 (212) 586-4901
3550 WILSHIRE BLVD., LOS ANGELES, CA 90010 (213) 380-8855
230 N. MICHIGAN AVE., CHICAGO, IL 60601 (312) 236-6899
POST BOX 342 T.D. CENTRE, TORONTO, CANADA (416) 362-3188
MIAMI, FLA (305) 944 7039, DALLAS, TEXAS (214) 234-2233,
SAN FRANCISCO, CA (415) 564-2973

mobility for such travels at about four to five weeks of age. (Nelson argues that they wander primarily to seek shade when both parents are foraging; overheating is a primary cause of death in booby chicks.) Yet hatchling boobies display only a few behaviors—little more than food begging and bill hiding (appeasement) gestures, as Nelson demonstrates—and the overriding signals for entrance into the ring are not among them.

The third species of the Galápagos, the white, or masked, booby, works on a more rigid system, but follows the same rules as its blue-footed cousin. Masked boobies are distant foragers, feeding primarily on flying fish. By Nelson's maxim, they should be able to raise but one chick. Sometimes, masked boobies lay only one egg, but usually they provision each nesting site with two. In this case, "brood reduction" (to use the somewhat euphemistic jargon) is obligatory. The older chick always pushes its younger sibling outside the nest (or occasionally stomps it to death within). This system seems, at first, to make no sense. The blue-foots, whatever our negative, if inappropriate, emotional reactions, at least use sibling murder as a device to match the number of chicks to a fluctuating supply of available food.

By what perverse logic should masked boobies produce two eggs, yet never rear more than one chick invariably branded with the mark of Cain? Nelson argues forcefully that clutches of two eggs represent an adaptation for greatly increased success in raising *one* chick. The causes of death in eggs and young hatchlings are numerous—siblings intent upon murder being only one of many dangers to which booby flesh is heir. Eggs crack or roll from the nest; tiny hatchlings easily overheat. The second egg may represent insurance against death of the first chick. A healthy first chick cancels the policy directly, but the added investment may benefit parents as a hedge worth the expense of producing another egg (they will, after all, never need to expend much energy in feeding an unnecessary second chick). At Kure Atoll in the Hawaiian Archipelago, for example, clutches of two eggs successfully fledged one chick in 68 percent of nests examined during three years. But clutches of one egg fledged their single chick only 32 percent of the time.

Evolutionary biologists, by long training and ingrained habit, tend to discuss such phenomena as the siblicide of boobies in the language of adaptation: how does a behavior that seems, at first sight, harmful and irrational really represent an adaptation finely honed by natural selection for the benefit of struggling individuals? Indeed, I have (and somewhat uncharacteristically for me) used the conventional language in this essay, for Nelson's work persuades me that siblicide is a Darwinian adaptation for maximizing the success of parents in rearing the largest number of chicks permitted by prevailing abundances of food.

But I am most uncomfortable in attributing the whole behavioral system, of which siblicide is but a specific manifestation, only to adaptation, although this too is usually done. I speak here of the basic style of intelligence that permits siblicide to work: the sailor's system (of my opening paragraph) based on yes-no decisions triggered by definite signals. John Alcock, for example, in a leading contemporary text (*Animal Behavior: An Evolutionary Approach*, 1975) argues over and over again that this common intellectual style is, in itself and in general, an adaptation directly fashioned by natural selection for optimal responses in prevailing environments: "Programmed responses are widespread," he writes, "because animals that base their behavior on relatively simple signals provided by important objects in their environment are likely to do the biologically proper thing."

(On the overwhelming power of natural selection, no less a personage than H.R.H. Prince Philip, duke of Edinburgh, has written in the preface to Nelson's popular book on birds of the Galápagos: "The process of natural selection has controlled the very minutest detail of every feature of the whole individual and the group to which it belongs." I do not cite this passage facetiously to win an argument by saddling a position I do not accept with a mock seal of royal approval but rather to indicate how widely the language of strict adaptation has moved beyond professional circles into the writing of well-informed amateurs.)

As I argued for siblicide and guano rings, I am prepared to view any specific manifestation of my sailor's intellectual style as an adaptation. But I cannot, as Alcock claims, view the style itself as no more than the optimized product of unconstrained natural selection. The smaller brain and more limited neural circuitry of nonhuman animals must impose, or at least encourage, intellectual styles different from our own. (Notice that I say different, not inferior.) These smaller brains may not be viewed as direct adaptations to any prevailing condition. They represent, rather, inherited structural constraints that limit the range of specific adaptations fashioned within their orbit. The sailor's style is a constraint that permits boobies to reduce their broods by exploiting a behavioral repertoire based on inflexible rules and simple triggers. Such a system would not work in humans, for parents will not cease to recognize their babies after a small and simple change in location. In human societies that practice infanticide (for ecological reasons that may be quite similar to those inducing siblicide in boobies), explicit social rules or venerated religious traditions—rather than mere duplicity by removal—must force or persuade parental action.

Birds may have originally developed their brain of characteristic size as an adaptation to life in an ancestral lineage more than 200 million years ago; the sailor's style of intelligence may be a nonadaptive consequence of this inherited design. Yet this style has set the boundaries of behavior ever since. Each individual behavior may be a lovely adaptation, but it must be fashioned within a prevailing constraint. Which is more important: the beauty of the adaptation or the constraint that limits it to a permissible path? We cannot and need not choose, for both factors define an essential tension that regulates all evolution.

The sources of organic form and behavior are manifold and include at least three primary categories. We have just discussed two of them: immediate adaptations fashioned by natural selection (exploitation by older booby siblings of a parental style of intelligence, leading to easy dispatch of nest mates); and potentially nonadaptive consequences of basic structural designs acting as constraints upon the pathways of adaptation (the intellectual style of yes-no decisions based on simple triggers).

In a third category, we find definite ancestral adaptations now used by descendants in different ways. Nelson has shown, for example, that boobies reinforce the pair-bond betwen male and female through a complex series of highly ritualized behaviors involving the gathering of objects and their presentation to mates. In boobies that lay their eggs upon the ground, these behaviors are clearly relics of actions that once served to gather material for ancestral nests—for some of the detailed motions that still build nests in related species are followed, while others have been lost. The egg-laying areas of masked boobies are strewn with appropriate bits of twigs and other nesting materials that adults gather for their mutual displays and then must sweep out of the egg-laying area to lie unused upon the ground. I have emphasized these curious changes in function in several previous columns, for they are the primary proof of evolution—forms and actions that only make sense in the light of a previous, inherited history.

When I wonder how three such disparate sources can lead to the harmonious structures that organisms embody, I temper my amazement by remembering the history of languages. Consider the amalgam that English represents—vestiges, borrowings, fusions. Yet poets continue to create things of beauty with it. Historical pathways and current uses are different aspects of a common subject. The pathways are intricate beyond all imagining, but only the hearty travelers remain with us.

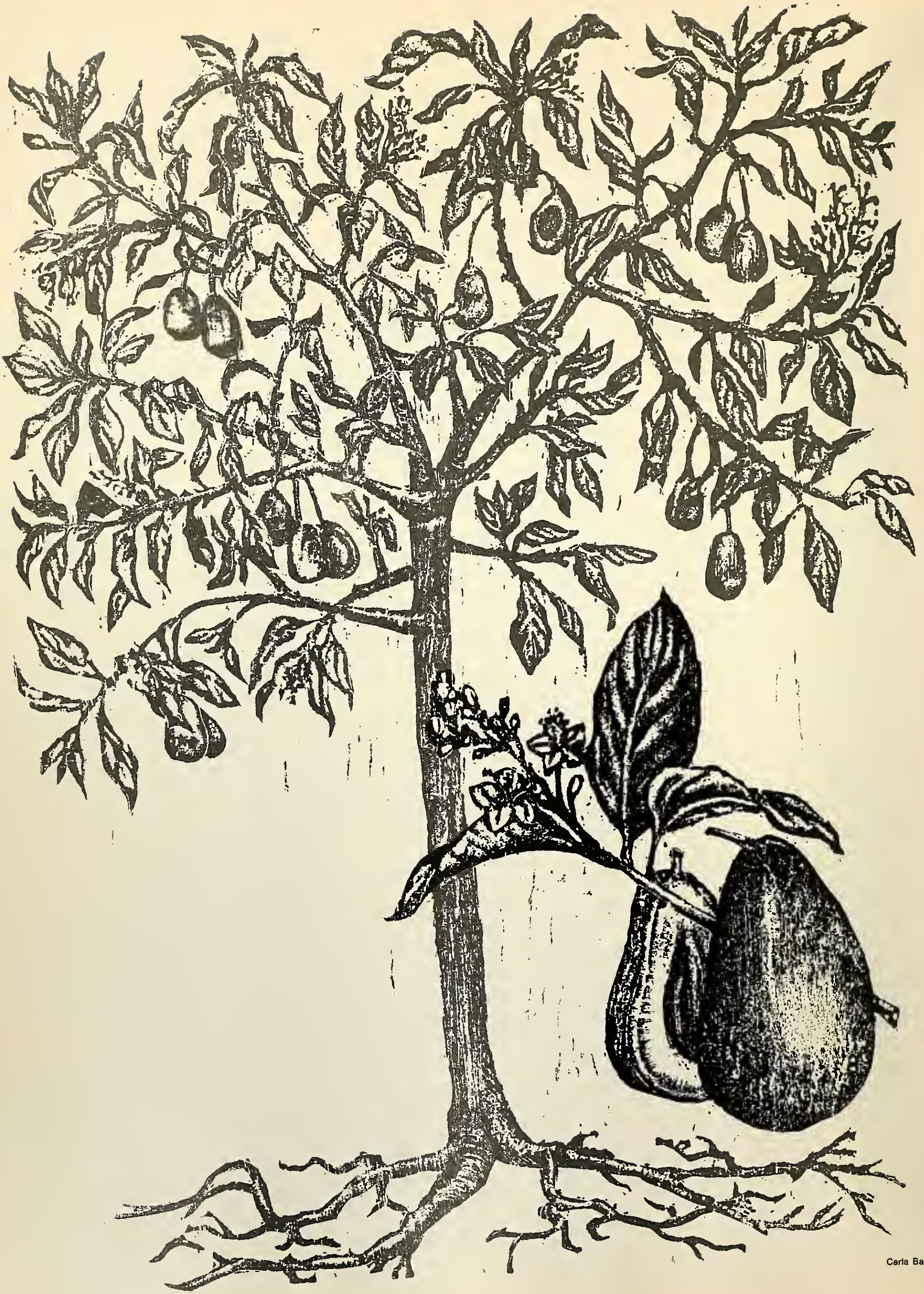
Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

"oooh"

Simply, splash a dash of Kahlúa in your hot or ice coffee. If you like, add a twist of lemon or lime. And do treat yourself to our Kahlúa recipe book. Yours for the sending.

Maidstone Wine & Spirits Inc.
P.O. Box 8925,
Universal City,
CA 91608.

KAHLÚA
IMPORTED FROM SUNNY MEXICO
KAHLÚA
LICOR DE CAFÉ
COFFEE LIQUEUR
PRODUCT OF MEXICO
KAHLUA S. A.
KAHLÚA® & Coffee
KAHLÚA® & Ice Coffee



Carla Bauer

Attractions of the Flesh

Many large-seeded plants produce fleshy fruits, an expensive but efficient way to accomplish dispersal

by Robert E. Cook

In the movie *Oh God!* George Burns reminisces about His achievements. As I remember, He says, after a thoughtful puff on a cigar, "It's not that I haven't made any mistakes. Take the avocado. The pit's too big."

The Lord put his finger on a real biological problem. After all, who would want to swallow the seed of an avocado? Recently, I measured the pits of four fruits that had gone into a salad. Each was slightly larger than a golf ball, about an inch and a half across, which is considerably thicker than any pill I care to consume. Consider the problem of fruits and their seeds as Darwin saw it in the *Origin of Species*. After noting that the beauty of flowers attracted the attention of pollinating insects, he wrote:

> A similar line of argument holds good with fruits; that a ripe strawberry or cherry is as pleasing to the eye as to the palate,—that the gaily-colored fruit of the spindlewood tree and the scarlet berries of the holly are beautiful objects—will be admitted by every one. But this beauty serves merely as a guide to birds and beasts, in order that the fruit may be devoured and the manured seeds disseminated.

What size of beast could happily dispatch a meal of wild avocados, seeds and all?

Darwin thought of the flesh of fruit as a kind of toll collected by a hungry animal from a reproducing plant in return for securing the safe passage of the plant's progeny to a new site and a chance for a better future. Movement away from the environment of the mother plant is especially critical in the dense vegetation of the tropical forest. Without the dispersal of seeds, the ground beneath the parent would become a carpet of small seedlings, struggling in the shade of the maternal canopy. Few, if any, would survive unless the parent were to suddenly expire. Offspring, therefore, must be conveyed to locations that facilitate growth. For example, a distant gap in a forest, created by a local disturbance, may provide a patch of light into which a sapling can expand its branches—if it can get there. The stomach of a bird or mammal may offer one means of travel. If the offspring is to survive the journey intact, however, the animal must be induced to swallow the seed for reasons other than the nutritional value of the seed itself. By providing a rich outer dressing of delicious flesh, the mother plant attracts animals in search of a meal while avoiding the destruction of her progeny. The drupes, berries, and melons found in nature may owe their existence to an ancient coevolution with some animal frugivore.

There is no greater symbol of seduction than fruit. Although it develops after pollination, fruit flesh is entirely the creation of the mother. It emerges from an elaborate differentiation of the flower or inflorescent tissue and forms a succulent pulp pleasing to the palate. The variety of fruit shapes and sizes derives from the diversity of maternal tissues that develop in different species. In pineapples and figs, for instance, the stalk supporting the floral ovaries ripens into fruit, while tomatoes and grapes form flesh directly from the ovarian wall. The development of most fruit can be conveniently divided into two phases—growth and maturation. Much of the actual growth in size occurs after fertilization of the maternal egg by a pollen nucleus but before ripening. The fruit of the small-flowered avocado, for example, multiplies its size more than 300,000 times before ripening. While this process requires some cell division, the major portion of weight increase involves the expansion of cells already present in the flower. This phase is initially dependent upon hormones produced by the seed. These cause the elaboration of a vascular network in the maternal tissue and the swelling of ovarian cells with fluid and solutes. Within each cell an extensible vacuole, or internal sac, is bounded by a porous membrane capable of regulating the contents. During growth, the vacuole becomes filled with metabolic byproducts, such as acids and tannins, that render the flesh bitter to human taste.

The maturation, or ripening, phase of fruit development involves a significant shift in metabolism and does not require the presence of the seed. In many species this phase is signaled by a rise and fall in the concentration of a new hormone, abscisic acid, in the maternal tissue and followed by the production of ethylene, a gaseous chemical that enhances ripening and causes the proverbial bad apple to ruin the whole barrel.

The swollen flesh of the fruit begins to soften as the rigid cell walls become viscous and elastic. Tissue astringency declines with the flushing of tannic acids from the vacuoles and the influx of sugars in solution. Each cell becomes scented with a distinctive aroma, and in many species, the deposition of brilliant pigments throughout the maternal tissue paints a striking contrast between the ripening fruit and the surrounding green leaves.

To the mother plant the cost of this ornamental ransom is considerable. Remember that the flesh, with its nutritional richness, is external to the seed and rots quickly upon dispersal. The growing embryo gains no benefits from the caloric content of the fruit and must survive entirely on its own reserves. Fruit flesh is superfluous to germination and serves only to seduce the disperser. Yet the pulp of a peach may equal the weight of its stone and be filled with energy that might have been invested in additional offspring.

The benefits of dispersal, therefore, must be considerable to have led to the evolution of expensive fruits. This evolution involved an interesting elaboration of the simple relationship between consuming animal and consumed plant. The earliest seeds were probably swallowed by reptiles more than 300 million years ago. Seed-eating animals usually digest most of the food they consume, and the evolutionary success of the mother hangs on the escape of some of her progeny from the searches of seed predators. Any traits that disguise the presence of seeds, such as small size and cryptic coloration, would clearly aid successful evasion. This places a tremendous constraint on seed size, however, which is in direct conflict with survival in the forest understory. To reach a gap in the canopy, aspiring seedlings require a large store of reserves provided by the mother. The evolutionary solution was a new relation between the plant and the animal. By combining a nutritious reward with a hard seed coat, the mother can avoid predation of her offspring and secure a passage to sites safe for establishment. Rather than concealing her seeds, she announces their presence, often with a conspicuous fanfare of color.

Presumably the ecological benefits of large seeds have justified the energetic costs of fruit, which may be particularly high in the avocado. The pulp cells of most species are filled with syrup, but in the avocado, up to 25 percent of the flesh is rich with oil. This constituent requires about half again as much energy to synthesize as the same quantity of sugar. Oil is an expensive way to travel. Does the quality of the passage merit the price?

Answering this question for the avocado may be impossible. The primitive variety of avocado, which coevolved with an unknown frugivore in primeval forests long ago, may no longer exist. Sometimes called the alligator pear, *Persea americana* apparently evolved in Central America near the highlands of southern Mexico and Guatemala, and the earliest Spanish explorers reported its extensive utilization by Indians as far south as Brazil and Peru. To be sure, this did not involve the planting of orchards, but the selection of fleshier fruits for barter and the casual dispersal of pits would have led to particularly large avocados growing around villages and markets.

The first trees were introduced into Florida about 1830, and commercial production in the United States began about the turn of the century. In 1916, the Office of Foreign Seed and Plant Introduction sent Wilson Popenoe, an agricultural explorer, on horseback into the wilderness of Guatemala in search of new varieties of avocado. In the Alta Verapaz Mountains of the north, Popenoe came upon several trees growing wild at the edge of the forest. He surmised that their fruit probably resembled the primitive form of the species. The round fruit was about the size of a small lime and had a relatively large pit in its center. The exceptionally thick exterior skin covered a thin layer of fibrous, oily flesh. The seed measured nearly an inch and a half across, only slightly smaller than many cultivated avocados. For our hypothetical frugivore millions of years ago, the reward of the wild avocado was much smaller than that of modern varieties, while the pit to be swallowed was still fairly large.

How can we assess the benefits of producing an expensive fruit containing oil? First we must find out something about the quality and efficiency of dispersal. The logic runs as follows. Successful establishment of offspring requires the movement of seeds away from the parent plant; otherwise fruit production would be wasteful and eliminated by natural selection. The amount of fruit to be produced depends upon the rewards required to seduce the appropriate frugivore, which in the case of the avocado must have been a rather large animal. To increase the reward, an avocado plant might allocate a larger fraction of each fruit to flesh at the expense of nutrition stored in the seed, but this would decrease the chance of a seedling reaching the light of the canopy. Therefore, to induce consumption of a large and bulky pit, the nutritional quality of the reward has been calorically amplified by natural selection. Our ancient frugivore has, in turn, evolved an appetite for oil and a willingness to consume the fruit, seed and all.

Tropical ecologists have hypothesized two syndromes of seed dispersal by frugivores. Plant species with small seeds, which usually require open habitats for establishment, attract a diverse array of fruit feeders whose rather general diet permits them to eat a wide range of species. Individual plants produce an abundance of conspicuous and aromatic fruit, each of which is relatively low in nutritional quality. The associated frugivores may be fairly inefficient in fruit dispersal, but the large number of seeds they consume compensates. Plant species with large seeds, which commonly grow in the forest interior, attract a smaller number of specialized frugivores, which provide efficient seed dispersal. Fewer fruits are produced, but each is richer in nutrition to insure consumption. Hence, the evolution of the oily avocado.

When this theory of alternative syndromes of dispersal first arose in the mid-seventies, few quantitative data existed with which to test it. Tracking the movement of seeds and fruits, particularly those consumed by animals, is nearly impossible. The lack of quantitative observation, however, also reflects an older bias in the interests of plant ecologists. In the early years of this century, the dispersal of plants was studied in order to explain the past and present distribution of whole plant communities. Attention focused on the capacity of individual species for long-range movement—for example, from one continent to another or northward expansion following glacial retreat. Ecologists collected reports of seeds that had traveled great distances: coconuts washed up on foreign shores and plumed achenes drifting thousands of feet in the air. Although the adaptive significance of fruit was suggested by the successful passage of seeds through the digestive track of a cherry-fed robin, little attention was paid to the *average* seed dispersed from a tree or to the various fates of the dispersed seedlings.

The rise of population ecology in the early years of the last decade introduced a new set of ideas concerning the significance of dispersal and brought a quanti-

Fill out this coupon and save the children

Complete this simple questionnaire, and befriend a needy child through Save the Children. For only fifty-two cents a day, your money, combined with that of other sponsors, can breathe new life into an impoverished village... help hardworking people in their fight for dignity... turn despair into hope for a child who has known only disaster. Fifty-two cents may not buy much where you live. But for the poorest of the poor where the need is so desperate, it can work miracles.

NH 1/2

My Name Is ______________________________
(please print)

Address ______________________________

City ____________ State ____________ Zip ________

Tell us how you want to help, by answering these questions:

1. What kind of child would you like to help?

☐ Boy ☐ Girl ☐ No preference

2. What geographical area are you interested in?

Urgent need exists in all the areas listed below, especially overseas. If you have a strong preference for a particular location, check the area of your choice. If not, won't you please let us assign a child where the need is greatest?

☐ **Certainly. Choose a child for me in an area of greatest need.**

I strongly prefer:

☐ Africa
☐ American Indian
☐ Bangladesh
☐ Chicano (U.S.)
☐ Colombia
☐ Dominican Republic
☐ Honduras
☐ Indonesia
☐ Inner Cities (U.S.)
☐ Israel
☐ Lebanon
☐ Mediterranean
☐ Mexico
☐ Nepal
☐ Southern States (U.S.)
☐ Sri Lanka (Ceylon)

3. Would you like a picture of your sponsored child?

Shortly after we select a child for you, we can send you a photograph and brief personal history, if you desire.

☐ Yes ☐ No

4. Would you like to exchange correspondence?

If desired, correspondence can build a meaningful one-to-one relationship and provide a unique educational experience for the sponsored child. In areas where illiteracy is high, a village representative will keep you informed of the progress your child is making. Translations, where necessary, are supplied by Save the Children.

☐ Yes ☐ No

5. Would you like information about the child's community?

When you become a sponsor, your funds are used to help children in the most effective way possible—by helping the entire community with projects and services. For health care, education, food production, and nutrition. Several times a year you can receive detailed reports on these community activities which provide permanent improvements to the child's environment. Would you like to receive such information?

☐ Yes ☐ No

6. How do you wish to send your sponsorship contribution?

Enclosed is my check for $________.

☐ Monthly, $16 ☐ Semi-annually, $96
☐ Quarterly, $48 ☐ Annually, $192

7. Do you wish verification of Save the Children credentials?

Save the Children is indeed proud of the handling of its funds. Based on last year's audit, an exceptionally large percentage (83.5%) of each dollar spent was used for program services and direct aid to children and their communities. Due to volunteered labor and materials, your donation provides your sponsored child with benefits worth many times your total gift. Would you like to receive an informative Annual Report (including a summary financial statement)?

☐ Yes ☐ No

(A complete audit statement is available upon request.)

8. Would you rather make a contribution than become a sponsor of an individual child at this time?

☐ Yes, enclosed is my contribution of $________.

☐ Check here for general information about our unique programs for aiding impoverished children.

Mail to:

David L. Guyer, President

Save the Children.®

50 Wilton Road, Westport, Connecticut 06880

YOUR SPONSORSHIP PAYMENTS AND CONTRIBUTIONS ARE U.S. INCOME TAX DEDUCTIBLE

Established 1932. The original U.S. child sponsorship agency. Member of the American Council of Voluntary Agencies for Foreign Service.

© 1981 SAVE THE CHILDREN FEDERATION, INC.

photo Bentley Kassal

tative approach to studies of adaptation. Ecologists realized that the migration of plant communities over vast tracts of land is limited less by the distances offspring disperse than by the ability of seedlings to establish residence in foreign soil. New questions began to appear. Does dispersal really benefit the offspring and favor their successful establishment? Why have different species evolved different dispersal mechanisms, some of which appear to be more costly than others?

Unfortunately, no one has sat beneath an avocado tree and watched the dispersal of offspring. Some quantitative studies on other tropical species have begun, however, and these may shed some light on the general benefits of costly dispersal. About six years ago, Henry Howe and his students at the University of Iowa began measuring fruit dispersal in tree populations growing near the Smithsonian Tropical Research Institute on Barro Colorado Island in Panama. *Tetragastris panamensis*, a local species, and *Virola surinamensis*, wild nutmeg, are two of more than 360 species of trees growing in the tropical rain forest of this region. Both produce a fruit capsule that dehisces, or bursts open, when ripe to reveal a brightly colored pulp, called an aril, which surrounds the seed or seeds. The aril develops from tissue within the ovary of the flower. Howe measured fruit production and dispersal by placing square traps of mosquito netting beneath the crowns of selected trees. Frugivores feeding in the canopy remove and swallow the aril, dropping the capsule beneath. Any fruits not consumed will eventually abscise and fall to the ground. This permitted Howe to estimate the proportion of the total fruit crop dispersed by calculating the ratio of fruit capsules without arillate seeds to capsules containing seeds. He combined this information with long hours of observation of frugivores feeding in the canopy to construct the dispersal biology of each species of tree.

During the period of observation, the average tree of both species devoted the same amount of energy to fruit production, but the two species packaged their reproductive efforts differently. The fleshy aril of the wild nutmeg is twice as large as that of *Tetragastris* and contains a much higher concentration of nutritious lipids and proteins, the latter in the form of tannins. The *Tetragastris* aril is primarily carbohydrate. The seed of *Virola* is a single, large pit averaging more than two grams, while each fruit of *Tetragastris* contains six seeds that are only one-tenth as large. In short, the nutmeg produces fewer, larger seeds, each accompanied by a richer reward.

Howe also found significant differences between the two trees in the proportion of the yield removed by animal dispersers. As with many plants, a great number of progeny ended up directly beneath the crown where they had little chance of surviving. *Tetragastris* had about 28 percent of its seeds dispersed to some other location in the forest, while the nutmeg had about 60 percent carried away. The difference in the quality of fruit appeared to yield more efficient transportation, for reasons that became clearer to Howe after long hours observing frugivores foraging in the canopy.

Howe saw twenty-six animal species feeding in *Tetragastris*, but nearly 70 percent of the fruits consumed in the crown were eaten by troops of howler monkeys, with the white-faced monkey and the racoonlike coati accounting for much of the rest. These mammals are immensely sloppy eaters, behaving like a pack of small children at a picnic. They rattle through the treetops, grabbing the sweet arils to eat, spitting seeds, and generating a rain of loose fruit and debris below. Eaten seeds are deposited in a fecal clump containing five or six pits, out of which only the first to germinate is likely to survive competition with its sibs.

By contrast, nutmeg frugivores dine with fastidious decorum. Howe observed only eight animal species feeding in *Virola*. Ninety percent of the fruit was eaten by five species of birds, with nearly half consumed by the chestnut-mandibled toucan. This elegant epicure, in brilliant attire for the occasion, perches delicately on the end of a branch and carefully extracts the oily aril from a capsule, as if it were eating oyster on the half shell. With the morsel securely clamped in its long beak, the toucan lifts off to a favorite perch nearby, perhaps to gain a better view of its surroundings. With a quick flip of its bill, the bird swallows the aril. The pulp is deftly cleaved off in the toucan's crop, and within thirty minutes, the single, intact seed is regurgitated onto the forest floor.

The low diversity of frugivores feeding in the crown of *Virola* is surprising in a forest with seventy-eight species of fruit-eating creatures. Why aren't more mammals attracted to the nutritious flesh of the nutmeg? Howe observed the occasional visit of a spider monkey. The animal snatches a ripe aril, sniffs it carefully, and as often as not, tosses it away without tasting it. With a high concentration of tannins, the fruit is quite bitter to the tongue of a primate.

Tetragastris and wild nutmeg nicely demonstrate the dichotomy in the quality of fruit dispersal. One species produces a mass of inexpensively dressed seeds, most of which are lost beneath the parent tree or in clumps of feces. The other prepares a meal of high quality to attract a more discerning connoisseur. Apparently the passage is worth the price: a higher proportion of offspring are carried away and deposited singly into the forest litter. Their fate after dispersal remains to be observed.

Still, the avocado remains a puzzle. Toucans are unlikely to swallow the enormous pits, and it is hard to imagine what frugivore could. Daniel Janzen, a tropical ecologist at the University of Pennsylvania, suggests that we might solve the puzzle of large pits by considering history. Ten thousand years ago, he writes, Central America was populated by a mammalian fauna of large herbivores and carnivores comparable to the inhabitants of the African savanna today. Mastodons, glyptodonts (related to armadillos), and giant ground sloths were probably the frugivores of yesterday, gathering to feed beneath fruiting trees, rapidly packing masses of oily flesh into their mouths, and later defecating seeds with hardly a sense of their passing. Over the last ten thousand years, this entire fauna has become extinct, leaving the oily fruits of many large-seeded species as evolutionary anachronisms, rotting beneath the parent tree.

At present, Janzen's hypothesis remains rather speculative, and it may never account for the remarkable evolution of the avocado. The idea is intriguing, however, and led me to recall some old observations of botanist Richard Spruce, who explored the western edges of the Amazon basin in the 1850s. He wrote, in *Notes of a Naturalist*:

> It is well known how fond all animals are of the Alligator Pear. I have seen cats prefer it to any other kind of food, and the wild catlike animals are said to be all passionately fond of it. I have been told by an Indian that in the forests between the Uaupas and the Japura Rivers he once came on four jaguars under a wild Alligator Pear tree, gnawing the fallen fruit and snarling over them as so many cats might do.

Robert E. Cook is associate professor of biology at Harvard University.

Face to face with another world.

You've been everywhere. You've seen everything. Lately you travel just for the ride. Explore another world. Come to Peru. Come to the country of incredibilities. Come to Machu Picchu, the city lost for four hundred years in an accumulated mountain of forest waste. Gaze in wonder on a city that was once the center of a colossal Incan civilization, larger by far, than ancient Rome's. Walk the complex of roads that would do a modern civil engineer proud. Admire the planning responsible for the liveability of this remarkable city.

Sure, you've seen ruins before. In Greece and in Rome. But Machu Picchu is not ruins. Put some thatch roofing on the houses and you could live there yourself.

When one thinks of Peru, Machu Picchu comes immediately to mind. But this city is just one of the incredibilities that make a visit to Peru so richly rewarding. Where else would you see a llama decorated for sacrifice on its way to the occasion in the most primitive of canoes? Everywhere such vestiges of a long forgotten civilization delight and surprise the eye.

You will see the work of goldsmiths and silversmiths second only to that of *Cellini*. Treasures like these were the undoing of the Incan empire, since they induced Spain's conquest of Peru under the leadership of Pizarro. Though this conquistador general took what he could, he could not take its beauty. So the grandeur he first looked upon is still ready for your eyes.

It is not an exaggeration to say that Peru is another world, a world of different encounters, different landscapes, different people, different art, different attitudes. Even if you've been everywhere on the globe, you haven't seen it all until you've seen Peru.

Here is a country out of sight but not out of reach. Find out from your travel agent, or send for fascinating literature that tells you what to see and what to know about Peru.

Peruvian Tourism Promotion Fund
1450 Coral Way, Suite 2
Miami, Florida 33145 NH 1/82

NAME

ADDRESS

CITY STATE ZIP

Peru
the country of incredibilities

Bali's New Gods

Can this fragile island withstand the massive influx of tourists?

by Colin Turnbull

To the Balinese their home is known as Pulau Dewata, or "Island of the Gods." But sometimes it seems that in the last few years the gods of Bali have descended in the form of tourists. With swimsuits and cameras as their sacred symbols, they appear to hold the power of both desecration and consecration.

The Balinese have traditionally considered their island to be safe as well as sacred, but tourism has changed that too; from tourism and tourists there is little safety. The government of Indonesia has done its best to contain the damage, both social and environmental, by confining tourists to the southern point of the island. But Bali is not much more than a hundred miles long and since it is both encircled and traversed by motor roads, only the western jungles are effectively free from the pollution that tourism brings. Even there, however, the people are not untouched. On this small and densely populated island (approaching three million people for its two thousand square miles), every village, if not every family, has somehow been affected by the massive influx of tourists, an influx so sudden and rapid, the islanders have had little time to adapt.

In would be easy enough to paint a totally negative picture of the impact of tourism on Bali. The once beautiful sandy beach at Kuta, for instance, is now littered with bodies in various stages of undress, interspersed with pimps, hawkers, and masseurs who move from body to body, plying their services. When I was there last year the beach was patrolled by two well-dressed prostitutes riding on scooters for ready pickup and delivery. Even the water was not entirely safe; to reach it one ran the risk of being run down by tourist youths racing and trick riding on motorcycles. And once in the water there was the danger of being hit by speedboats, towing large rubber dinghies loaded with shrieking tourists who seemed to have come thousands of miles to do what they could have done at home.

Yet the local fishermen, whose beach it used to be, continued to go about their business as though none of these intrusions were going on. And sunset was still a beautiful time of day. Kuta Beach is renowned for its sunsets, but apart from some scattered photographers, few tourists are to be found there in the twilight; after all it is cocktail time, and sunsets look just as good from a comfortable lounge, with drink in hand.

Bali's modernization, urban development, and extraordinary economic growth, with all the corresponding benefits of medical, social, and educational services that had previously not existed, also have their negative aspects. It could be argued that prior to the descent of the tourist gods, for whose benefit the island seems largely to be administered, some of these services were not needed; they are needed now to combat problems brought by tourism itself. The economic benefits touch only a few, and the cost to all is high in terms of damage to the social fabric. How high might be measured by the increase in the rate of teen-age suicide.

Nevertheless, tourism is of major, often paramount, economic and even political importance in many remote parts of the world, and one of the major issues that has to be faced is how to weigh the complex advantages against the equally complex disadvantages. Here my focus is on one small segment of the overall problem of the social change induced by tourism: the interaction between the tourist and what is sacred to the people of the place he is visiting. In a vast subcontinent such as India even the most profane tourists are likely to have little effect on what is sacred to the Indian; on a small island like Bali, it is another matter. The Balinese people's way of life is intimately bound up with their religious belief and practice, and there are some 30,000 temples on the island, so the possibility and danger of desecration are very real. But in looking at the desecration and how it takes place, most often unconsciously at the hands of tourists, we find there is also a kind of consecration taking place.

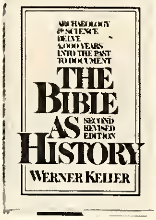
In line with my ongoing analogy between tourism and pilgrimage, of all tourist meccas surely Bali is one that is truly sacred. The quest of most tourists going there involves an ideal of perfection, of beauty and goodness—which, incidentally, are qualities by which the Balinese religion defines the sacred. Since for the Balinese the land itself is sacred, the very environmental and ecological changes wrought in the name of tourism or by tourists are a form of desecration. And since reciprocity in human relationships is also sacred in their essentially egalitarian traditional way of life, the abuse of money is also a form of desecration. With money they have learned to "purchase" human services for individual gain, without involving any further reciprocal personal obligation. Money all too easily and subtly short-circuits mutual concern and consideration. This effect of tourism is perhaps most insidious and most pervasive in a cultural setting such as Bali. What is a small amount of money for the tourist may be a small fortune to the Balinese. Individual wealth in such measure, together with other material appurtenances of Western civilization brought by tourism, readily lures young men and women, even boys and girls, away from their homes and villages. Too late, they discover they have also been lured away from the security their traditions offered and from the ideals their lives were built around.

At the individual level, desecration by tourists may be conscious or unconscious. On Bali it is most often the latter; vandalism, such as the scarification of sacred monuments by graffiti and pilferage from sacred sites, is not yet as common as elsewhere. But it is curious

SAVINGS THAT GO DOWN IN HISTORY
TAKE ANY 3 ALL FOR $1.99
(with trial membership)

THE ETRUSCANS
Michael Grant
2683. $17.95/**$12.95**

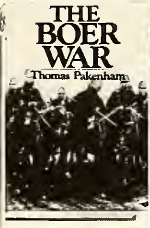
BYZANTIVM
THE EMPIRE OF NEW ROME
CYRIL MANGO
2840. $17.50 **$12.95**

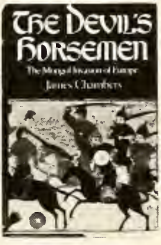

THE BIBLE AS HISTORY
SECOND REVISED EDITION
WERNER KELLER
3012. $14.95/**$10.95**

R.J. HOPPER
The Early Greeks
5504. $25.00/**$13.00**

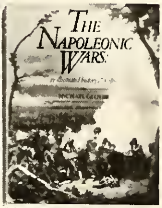
THE ARTHURIAN LEGENDS
8656. $19.50/**$13.95**

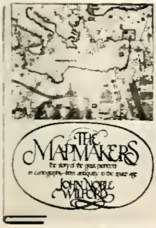
HISTORY OF ROME
Michael Grant
7401. $17.50/**$11.50**

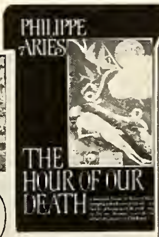

THE BOER WAR
Thomas Pakenham
8466. $20.00/**$12.50**

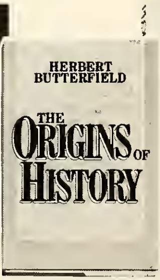

The Devil's Horsemen
The Mongol Invasion of Europe
James Chambers
8284. $11.95/**$8.95**

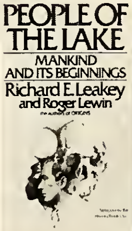
The Hundred Years War
BY DESMOND SEWARD
2493. $14.95/**$10.95**


The Napoleonic Wars
7849. $22.50/**$12.95**


THE MAPMAKERS
JOHN NOBLE WILFORD
3459. $20.00/**$13.95**


PHILIPPE ARIES
THE HOUR OF OUR DEATH
3004. $20.00/**$13.50**


HERBERT BUTTERFIELD
THE ORIGINS OF HISTORY
3715. $20.00/**$12.95**


PEOPLE OF THE LAKE
MANKIND AND ITS BEGINNINGS
Richard E. Leakey and Roger Lewin
7336. $10.95/**$8.95**

STONEHENGE AND ITS MYSTERIES
MICHAEL BALFOUR
8847. $14.95/**$9.90**

(First price is publisher's list. **Boldface** shows member's price.)

FALLEN EMPIRES FLOURISHING LEGACIES

4143. **Russia Under The Old Regime.** *By Richard Pipes.* The first thorough analysis of the growth of the Russian state. $17.50/**$10.95**

4788. **China's Imperial Past: An Introduction to Chinese History and Culture.** *By Charles O. Hucker.* $17.50/**$11.95**

2170. **Lost Country Life.** *By Dorothy Hartley.* How English folk lived, worked, threshed, thatched, rolled fleece, milled corn, brewed mead $14.95/**$9.90**

3293. **Riddles In the British Landscape.** *By Richard Muir.* An exploration of ancient monuments and landscape features as clues to puzzling aspects of Britain's past. $17.95/**$12.95**

5462. **The Celts: The People Who Came Out of the Darkness.** *By Gerhard Herm.* $12.50/**$8.50**

AGGRESSION, CONFLICT AND DIPLOMACY

2725. **The Days of the French Revolution.** *By Christopher Hibbert.* $12.95/**$9.95**

7583. **The Great Mutiny: India 1857.** *By Christopher Hibbert.* $15.95/**$9.95**

3871. **The Gate of Heavenly Peace: The Chinese And Their Revolution, 1895-1980.** *By Jonathan D. Spence.* $19.95/**$12.95**

3640. **Bad Blood: The Tuskegee Syphilis Experiment.** *By James H. Jones.* The shocking details of this experiment on 399 black men in the rural South. $14.95/**$10.95**

3723. **Infiltration: How Heinrich Himmler Schemed To Build An SS Industrial Empire.** *By Albert Speer.* $15.95/**$11.95**

SHAPING HISTORY: THE MEN AND THE ISSUES

3368. **Custer and The Little Big Horn.** *By Charles K. Hofling, MD.* $15.95/**$10.95**

4648. **The Twelve Caesars.** *By Michael Grant.* $12.50/**$8.75**

7765. **Richard the Lionheart.** *By John Gillingham.* $12.50/**$8.50**

8938. **The Gnostic Gospels.** *By Elaine Pagels.* $10.00/**$8.50**

3228. **Grant: A Biography.** *By William S. McFeely.* Treats both the military and political careers. $19.95/**$12.95**

CA82A

No matter what areas of history you enjoy reading about most, you'll find that The History Book Club offers some of the finest selections being published today. And no book club we know of offers greater savings—an average of 33% off publishers' list prices.

You can save even more now by taking advantage of our introductory offer. Select any 3 books on this page all for just $1.99 (values up to $67.50) when you take a fourth book at the low member's price. Your total savings as a trial member, including this introductory offer, can be more than 50%.

How the Club Works: As a Club member, you'll be able to choose from the 150-175 books featured each month. Our books are always equal to the publishers' editions never "economy reprints" and at savings of $3, $4, $5, or more off bookstore prices. You need take only four more books in the next two years, after which you'll save even more through bonus books which you may choose from our entire list.

Every four weeks (13 times a year) you will receive our *Review* and a dated reply card. If you want the Editors' Choice, do nothing, the book will come automatically. If you want another book, or no book at all, return the card by the date specified. (Book shipments will be charged to your account at low member's prices, plus postage-and-packing.)

If you should get an unwanted book because you had less than 10 days to decide, you may return it and pay nothing. We guarantee postage.

THE HISTORY BOOK CLUB Stamford, Conn. 06904

Please enroll me as a trial member and send me the four books whose numbers I have entered below. Bill those on the left at $1.99 for all three and the fourth at the low member's price, plus postage-and-packing.

☐ ☐ ☐ ☐

I may return the books within three weeks at your expense and owe nothing. Or, I will buy four more selections within the next two years (*not counting my choices above.*) Membership is cancellable anytime thereafter. All Club purchases are at low member's prices, and a postage-and-packing fee is added to all shipments. NH-560K

Print Name______________________________

Address_________________________Apt. #______

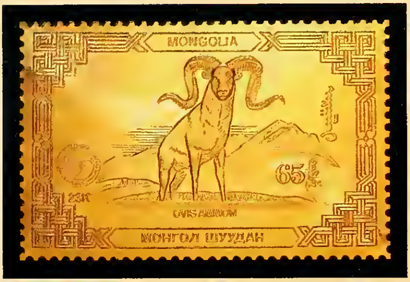
City___________________________________

State________________________Zip___________

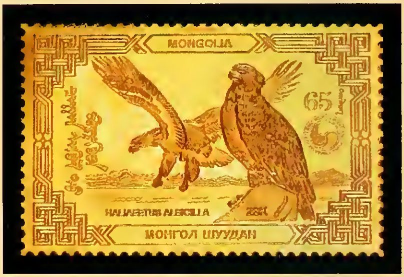
In Canada: Mail to The History Book Club, Stamford, Conn. 06904

THE LIVING TREASU

Collect the Splendors of Earth's Priceles
Immortalized Foreve

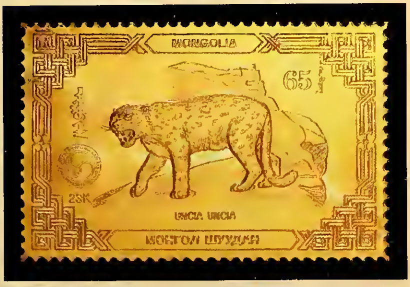

MONGOLIA
65
23K
OVIS AMMON
МОНГОЛ ШУУДАН

ARGALI

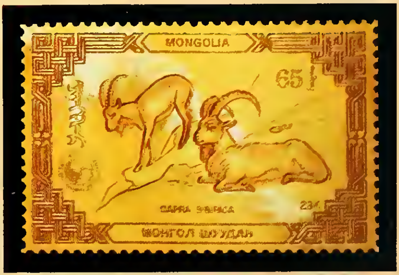

MONGOLIA
65
HALIAEETUS ALBICILLA
23K
МОНГОЛ ШУУДАН

WHITE-TAILED SEA EAGLE

STAMPS SHOWN ***ACTUAL SIZE***

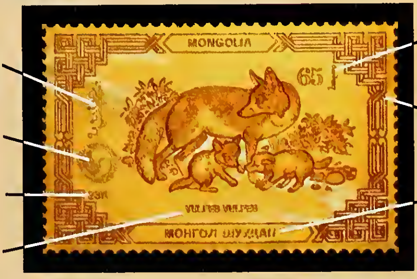

MONGOLIA
65
23K
UNCIA UNCIA
МОНГОЛ ШУУДАН

SNOW LEOPARD


MONGOLIA
65
CAPRA SIBIRICA
23K
МОНГОЛ ШУУДАН

SIBERIAN IBEX

RED FOX


MONGOLIA
65
23K
VULPES VULPES
МОНГОЛ ШУУДАН

Name of each animal in traditional Mongolian language

Official seal of the Mongolian Society for Conservation of Nature

23 Karat Gold mark certifies the quality of each stamp

Scientific name of protected animal in Latin

Stamp denomination in Mongolian language

Ancient Mongolian border design symbolizes happiness and equality

Country designation is also inscribed in Eastern Cyrillic language

Featuring 30 Rare, Endangered Animals and Birds of Mongolia

Note: To comply with governmental regulations, stamps illustrated have been overprinted.

RES OF ASIA

23 Karat Gold Official Stamp Collection

Riches of Vanishing Wildlife...
in 23 Karat Gold

MONGOLIA — a nation of mysterious wonders — where certain rare species of wild horse, antelope, marmot, bear and beaver can be found that exist *nowhere else*. This exotic land of vast deserts and towering mountains is a paradise for some of the rarest wildlife in the world today.

Now, the Mongolian Government honors its cherished national heritage with a very special series of 30 commemorative postage stamps — minted in 23 Karat Gold. Each is an original art rendering in precious metal capturing one of nature's wild creatures that is uniquely Mongolian.

The Living Treasures of Asia collection includes tributes to Przewalski's Horse, the last authentic wild horse in the world . . . the Siberian Ibex, with horns forming a crown over four feet wide . . . the Saiga Antelope, with a body of a deer and nose of an elephant . . . the wild Bactrian Camel, of which, according to the World Wildlife Fund, less than 250 still exist . . . and other such fabled creatures, as wonderful as the extraordinary land they inhabit.

The breathtakingly beautiful and detailed designs are the result of exhaustive efforts by government wildlife research teams to ensure that every detail is painstakingly exact. Each pose and setting had to be verified, authenticated, then approved as it came off the easel of one of the nation's most skilled artists.

The same meticulous care was taken by master engravers in creating the minting dies. And again, in the precise minting process that captured such incredible beauty forever in the warmth and richness of Gold.

Double-struck minted for Proof quality, each design appears as an accurate three-dimensional sculpture — just like those found on the most beautiful and desirable Gold Proof Coins. High relief raised surfaces are exquisitely frosted, and contrasting flat areas are brilliantly mirror-like. The natural recreations of the endangered species could not have been achieved by any other method than the costly but exacting medallic art form.

The 23 Karat Gold in this collection will encompass a generous expanse totalling almost 100 square inches. What better way to preserve these magnificent creatures of nature than in the eternal glory of this precious metal from the very heart of the earth itself. This collection is destined to become one of your most prized possessions, indeed, it may well become a family heirloom.

A strictly limited edition, no more than 20,000 of these sets will be issued worldwide. Thus, the scarcity of these valuable medallic artworks is assured forever.

The Mongolian Government appointed Calhoun's Collectors Society as exclusive U.S. distributors of these exceptional wildlife issues. Subscribers will receive the 23 Karat Gold Official Stamps at the convenient rate of one per month at the original issue price of just $19.50 (just about face value) per stamp. At no additional charge, you will also receive a custom album, plus authoritative and informative pages of background material on the wildlife.

Your satisfaction is 100% guaranteed. When your first stamp arrives, take 15 days to examine it in your own home. You will have the opportunity to see for yourself how very special these Gold wildlife tributes are. Keep it only if you are totally delighted, otherwise simply return it for a full refund. You risk absolutely nothing.

Send no money now. You will be notified upon acceptance of your application. Then you will be billed for each stamp prior to shipment. However, to be sure of acquiring The Living Treasures of Asia, you are urged to fill out the Application below and return it immediately, before the March 15th deadline.

You'll find all these protected animals depicted in the collection

ARGALI
RED DEER
ASIATIC WILD ASS
SNOW LEOPARD
CRESTED PELICAN
RED FOX
MUSK DEER
BEARDED VULTURE
COMMON OTTER
BACTRIAN CAMEL
WHITE-NAPED CRANE
REINDEER
TIBETAN BEAR
EAGLE OWL
SAIGA ANTELOPE
MONGOLIAN MARMOT
MUTE SWAN
PRZEWALSKI'S HORSE
SABLE
SIBERIAN IBEX
WHITE-TAILED SEA EAGLE
MOOSE
BEECH MARTEN
BLACK STORK
UPLAND BUZZARD
BAR-HEADED GOOSE
MONGOLIAN PHEASANT
MONGOLIAN BEAVER
BLACK VULTURE
GOITERED GAZELLE

MAIL YOUR SUBSCRIPTION APPLICATION TODAY

Calhoun's Collectors Society
7275 Bush Lake Road • P.O. Box 1218 • Minneapolis, Minnesota 55440

SUBSCRIPTION APPLICATION

Calhoun's Collectors Society, Inc.
7275 Bush Lake Road
P.O. Box 1218, Minneapolis, MN 55440

APPLICATION DEADLINE:
MAIL BEFORE MARCH 15, 1982
SEND NO MONEY NOW

☐ Please accept my Application to subscribe to The Living Treasures of Asia Collection consisting of 30 Gold Stamps from Mongolia.

I need send no money now. If accepted, I will be billed prior to shipment of my first stamp ($19.50* plus $1.25 postage and handling for each). Stamps will be shipped at the rate of one per month for 30 months.

Signature ______________________ (Required)

☐ Ms. ☐ Mrs. ☐ Miss ☐ Mr.
(Please specify) ______________________ (Print name clearly)

Address ______________________

City ______________________

State, Zip ______________________

SATISFACTION GUARANTEED
1832-FAI
1432-KAS

*Minnesota residents please add 5% (98¢) sales tax.

© 1982 Calhoun's Collectors Society

that the most conscious, blatant, and offensive insults are given at the most sacred places and on the most sacred occasions. Sometimes it is the tourist industry itself, through the initiative of local entrepreneurs, that overtly desecrates what is holiest, but individual tourists do their share of conscious profanation. For instance, even at Pura Besakih (the Mother Temple) on Mount Agung, probably the holiest shrine in Bali, I saw some tourists openly ignore polite requests not to enter certain areas. They swaggered wherever they wished, openly ridiculing the sense of propriety so sacred to the Balinese, making loud and coarse jokes concerning customs of modesty in dress and nonadmission of women during their menstrual period. And down the coast at Goa Lawah, the sacred home of the mythical serpent Basuki is noted by most tourists merely for the quantity of bats that infest the cave. The associated temple, a holy place reserved largely for death ceremonies, is ignored or paid scant courtesy at best. Crowds of tourists press through worshipers to see and photograph the bats or push among mourners to take snapshots of a funerary ritual. I saw three particularly unkempt and scantily dressed youths force their way up the steps, ignoring requests to put on the required ritual waist sash readily available to all foreign visitors and ridiculing the offered wraparound apron that would have concealed the immodesty of their very short shorts. They burst among the mourners with whoops and jeers, and one tried to throw stones into the cave to dislodge the bats. Eventually a little old Balinese priest came up to them and politely asked them to leave. There was something about that tiny man that stopped them in their tracks. They looked at each other in surprise, then with a few more self-conscious gymnastics and coarse comments they bounded down the long flight of steps, laughing as they knocked people aside.

I caught up with them on the nearby beach of volcanic lava. All their bounce and bravado had gone; they were arguing about just why they had listened to that silly little old man. After all, they had come all that way to see the bats and they had as much right to be there as anyone else. But none of them suggested turning around and going back. They had been touched by something—and stopped. The Balinese might say that the youths had been stopped by the gods. It was certainly no threat of physical coercion that had prevented them from "having their fun"; and plainly they had no respect for the "silly little old man" or the religion he professed. But evidently he somehow commanded an air of authority that was just as effective as that of any armed policeman or bouncer. I will not insist that the authority was sacred in the sense that any supernatural force was at work, but whatever the source, it was powerful enough to prevent an act of desecration. It touched the desecraters, too, and for a moment compelled them to acknowledge the existence of something sacred to others.

The abusive and offensive behavior of these three young men also affected the rest of us. It annoyed the photographers and those trying to film the mourning ceremony, particularly when one of the three bearded, bandannaed heads popped into a viewfinder. It caused a few to stop taking photographs. What it did to the Balinese I cannot say; apart from the priest who intervened they seemed to pay no attention. Perhaps it merely heightened their awareness of the sanctity of the place and the worship they were about; perhaps that is what it did for all of us.

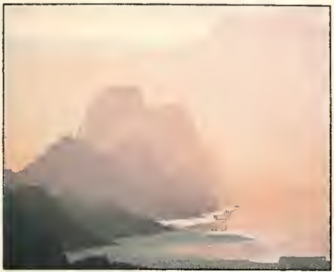
For those who are uncomfortable with the word *sacred*, some Balinese whom I talked with about this and similar incidents use the word *respect*. The young manager of a beach resort was very clear and emphatic. He did not object to the behavior itself; Basuki, after all, was perfectly capable of looking after himself and could have struck the youths dead. It was rather the lack of human consideration that offended him. More than this overt act of desecration or, only slightly less overt, the insulting condescension of tourists in his hotel, on the beach, or on the streets, he found their manner of dress objectionable. This for him was true desecration. To attack the gods directly is merely foolhardy and ignorant. But to attack the sanctity of "proper human relationships" is an insult and a threat that is as real as it is mortal. Much of Balinese social structure is built around the concept of propriety, and despite the outward appearances of freedom and relaxation, there is an underlying code, which is specific and rigorous, concerning mutual relationships. That code clearly defines the acceptable limits of behavior, and dress is an important element. Other than when bathing, men in shorts are indecent, and without shirts they offer open insult; the same is true for women. On the beach, the pimps, hawkers, masseurs, and even the two motorized prostitutes were all impeccably dressed, the women with blouses buttoned up to the neck and the men in long trousers and open-neck shirts fastened as high as they would go. Even the totally naked fishermen somehow gave the appearance of being fully clad, in respectability at least, as they entered or emerged from the water casually concealing their genitals with the left hand, their neat piles of clothes close to the water's edge.

The hotel manager came from the north coast of Bali and talked longingly and lovingly of "the other side of the island," of its beauty and safety. By "safety" he was not referring to physical safety. His home was only a few hours drive away, but he had never been back and said he could not return there. "Like the rest of us who have left our homes, I am not clean. Look at how I dress." He was considerably better dressed than I was, but in Western style. Yet he was in no way bitter or hostile to tourism. He was grateful for the new horizons it had opened up to him and to the island, and while aware of the damage being done to the traditional way of life, he pointed out that he and others were now more aware that they had something to lose. When I asked him what he had gained, other than this knowledge, his Western clothes and dark glasses, his home without a family, and his scooter (all things that he listed), he gave an odd answer. He said, "Now I know there is even more for me to respect."

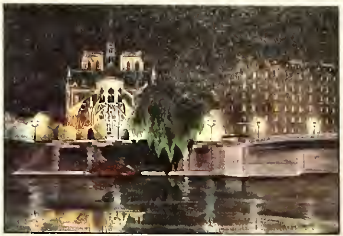
At the beginning I referred to tourists as the new gods of Bali, with swimsuits and cameras as their sacred symbols, holding the power of desecration and consecration. This was not entirely flippant. One brochure in front of me describes Bali, not as "Island of the Gods," but as a "Photographer's Paradise." And under "Emergencies" it lists four: police, hospital, ambulance, and finally, camera troubles. Since so many of us take cameras with us when we travel abroad we should be aware of the possible sacral power of this device and the way that we handle it.

One could do an amusing study of the ritual behavior of photographers, but that is not what I have in mind. I have in mind what is very clearly in the minds of Muslims when they prohibit photography of the human form, and what the Jewish scriptures had in mind when they forbade graven images. It is the ancient idea of "quintessence," that fifth and *essential* ingredient that was thought to be latent in all being—the stuff of the stars, some thought, the stuff of sanctity

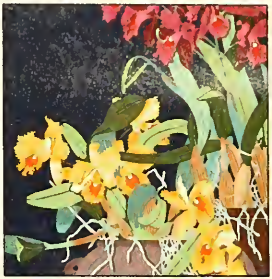
What your home could have in common with the Met, the Tate, and the Louvre.



Jerome Schurr's *Condor Point*, original serigraph. Signed limited edition of 290.



Jean-Luc Lecoindre's *Notre Dame de Paris*, original lithograph. Signed limited edition of 175.



Tjelda Michas' *Brazilian Orchids*, original serigraph. Signed limited edition of 250.

In your own home, you can exhibit original work by artists who are represented in the world's great museums and galleries.

Artists like Calder. Chagall. Dali. Miró. Picasso. Vasarely.

At the Original Print Collectors Group, we offer moderately priced limited edition prints by these and other well-known artists.

Our offerings include signed original etchings, engravings, and silk-screen prints.

Each print we offer is signed and numbered by the artist. Custom-framed. Accompanied by a certificate of authenticity and a full money-back guarantee.

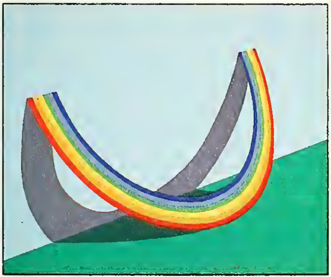
And each print has been chosen not only for its beauty but for its investment value.

(Works by the artists we offer tend to appreciate, sometimes as much as 30% in a single year. Perhaps that's why *The Wall Street Journal, Business Week, Money*, AP, *Barron's* and UPI have quoted us as an authority on investing in art.)

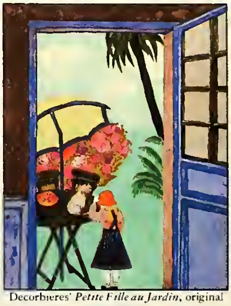
For more information, send in the coupon. There's no obligation.

You'll find out about the special pleasure of owning original art, instead of just visiting it.

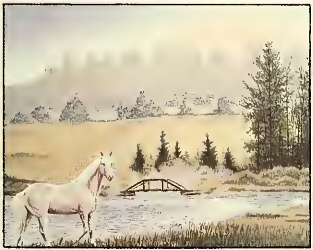
Visit our new gallery located at 215 Lexington Avenue,
Mon–Fri, 9–5 PM. Telephone: 212-685-9400 Ext: 35



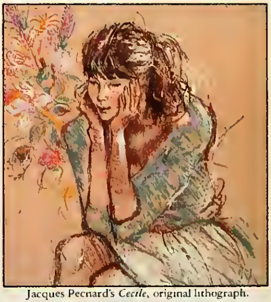
Patrick Hughes' *Rest of the Rainbow*, original serigraph. Signed limited edition of 225.



Decorbieres' *Petite Fille au Jardin*, original lithograph. Signed limited edition of 300.



Werner Rentsch's *Early Morning*, original lithograph. Signed limited edition of 275.



Jacques Pecnard's *Cecile*, original lithograph. Signed limited edition of 150.

Original print collectors group, Ltd.

215 LEXINGTON AVE., DEPT. NH-35,
NEW YORK 10016

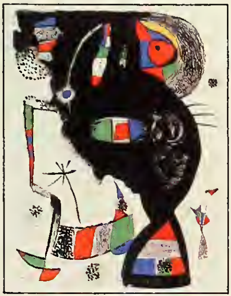
PLEASE SEND ME YOUR FREE COLOR
CATALOGUE WITHOUT OBLIGATION.

NAME ______________________
PLEASE PRINT

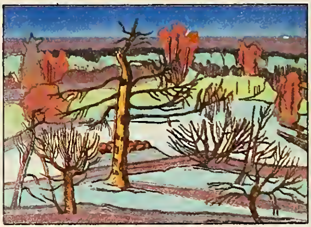
ADDRESS ______________________

CITY ______________________

STATE ______________ ZIP ______________

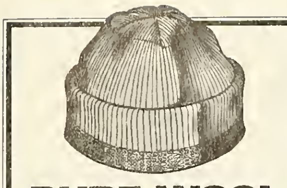


Joan Miró's *45 Rue Blomet*, original lithograph. Signed limited edition of 100.



Jarle Rosseland's *Strength of Winter*, original woodcut. Signed limited edition of 225.

© 1982 OPCG, LTD



PURE WOOL WATCH CAP

This is the genuine article...made for us by the same mill that knits them for the military. Warm and strong worsted wool is knit tight and flat to keep its shape. Wear the cuff doubled or pulled down to protect ears, neck and forehead. Rolls for stowing in gear bag or glove box. One size fits all. **Colors:** Navy Blue or Gold. **Wool Watch Cap $5.50** postpaid.

Order Today! Money Back Guarantee!

Here is my check or money order for $ ________
(Add sales tax for shipment into CA, CO, D.C., IL, MA, MI, MN, PA, WA.)
#1760 Wool Watch Cap Color ________
Name ________
Address ________
City ________
State ________ Zip ________
☐ **Send me your FREE outdoor catalog.**

Eddie Bauer®

Dept. PNH, Fifth & Union, Seattle, WA 98124

THE WOMAN THAT NEVER EVOLVED

Sarah Blaffer Hrdy

What does it mean to be female? Sociobiologist and feminist Sarah Blaffer Hrdy shows us that evolutionary biology can provide surprising answers. She introduces us to our nearest female relatives – highly competitive, independent, sexually assertive female primates.

Hrdy proves that the sexually passive, non-competitive, all-nurturing woman of prevailing myth never could have evolved within the primate order.

"Brilliant... An exciting, pathbreaking book, and splendidly readable." — Ashley Montagu

$17.50 Illustrated

At your local bookstore, or directly from

Harvard University Press
79 Garden Street,
Cambridge, MA 02138

and divinity. No representation of man (or God) that does not show that inner reality can do justice to man or God. Since the quintessence is invisible, any pictorial or graven image is wanting, and failing to do justice to a divinity is a desecration.

I think most of us—even the most profane, the most irreligious—have something that to us is sacred. I doubt if many could put their finger on what the invisible quintessence of that sacredness is, any more than the ancients could when they coined the word. But we are aware of its presence. It is what sometimes motivates us to take photographs, and it is very definitely what sometimes motivates us *not* to take photographs. Probably most of us have had moments when, camera in hand, we have seen something deeply moving, so beautiful that it seemed made for photography, yet somehow we came away with the shutter still cocked, the camera unused. The Balinese would call that an act of "respect." We might say it was because the light was not right, but even that excuse is to say that our mechanical apparatus was, at that moment, incapable of making a perfect image of what we "saw."

Or we might recognize that what we saw with our eyes was not really what we wished to capture, that any photographic rendition without the smell, the touch, the feeling, without that indefinable quintessence, would be a failure. Like most other tourists at Kuta Beach I watched sunsets. I watched *every* sunset, and I watched from the beach, bare feet in the sand. And like others I took photographs. They are probably like those everyone else took, and while they are spectacular, they do not have that essential that made some moments standing on the beach in the warm air, with the smell and sound of the surf, sacred. All the photographs do is to help recall the sunsets that were sacred because they occurred when I deliberately went out to the beach *without* my camera, to be a part of the sunset instead of a detached, objective observer.

So it was at the temples of Bali (and of course elsewhere). The act of photography seems on the one hand to diminish what is being photographed by making it commonplace or to insult it by the futility of trying to capture its invisible essence; on the other hand the photographer is demeaned if he or she doesn't realize that there *is* an invisible essence. I observed Balinese noting with obvious approval or disapproval the manner and mood of the photographer. There were times when a cluck of disapproval was heard as a tourist took a quick snapshot of something particularly sacred, hurrying on with hardly a pause or second glance. Then there were times when the photographer's intense concentration, and rigid requirements for perfect conditions, conveyed a sense of respect and brought a quiet sigh of approval; for respect, whatever its origin, can only serve to heighten rather than diminish what is sacred. The drawback is that the act of taking a photograph too often puts a distance between the photographer and the object being photographed. For the tourist in particular there is often neither the time nor the opportunity to empathize and identify in a way that makes for outstanding photography, which is a true art. The snapshot is literally a "taking" and may serve to remove the tourist even further from the very thing he most wants to approach and share.

The cost of using the lure of photography to attract tourists to Bali can be high. The narrow streets of Kuta are lined with indigenous tourist agencies, car hire firms, and bus operators. Outside their one-room offices are blackboards and posters advertising their "specials." The sacred gets top priority and commands the highest price, but how long can the sacred remain intact when subject to such commercialization? Even death is not immune. The most lurid and colorful posters call tourists to come and enjoy cremations—one advertised a mass cremation. For many Balinese the cost of living has grown so enormously that they can no longer afford to finance a cremation for a single family member, so the dead are pooled, so to speak, and the conflagration is made even more dramatic by the glare of floodlights, the explosion of flashbulbs, and the presence of the new gods.

There was even an "underground" tourist traffic in death, surreptitious visits to a lakeside beach where the bodies of the dead are laid out in the open. I wonder how many have the stomach to show such photographs to their friends, and what they say about the custom. I found I did not have the stomach to go and find out. I confined most of my photography thereafter to the profane; mainly to photographs of other tourists at work with their cameras.

Colin Turnbull, formerly associate curator of African ethnology at the American Museum of Natural History, is visiting professor of anthropology at George Washington University.

Now–A Record Club With No Obligation!

Choose Any 3 or 4 Record Set

For Only $3.98

FELIX MENDELSSOHN BARTHOLDY
5 SYMPHONIES
HERBERT VON KARAJAN
BERLIN PHILHARMONIC ORCHESTRA

MENDELSSOHN 5 Symphonies (4 LPs) *von Karajan: Berlin Philharmonic Orchestra*
LPs #78; Cassettes #79

Bach
Messe h-moll
Mass in B minor
Messe en si mineur
CHORUS & ACADEMY OF ST MARTIN-IN-THE-FIELDS

BACH Mass in B Minor (3 LPs) *Marshall, Baker, Tear, Ramey, Marriner: Academy of St. Martin-in-the-Fields*
LPs #81; Cassettes #91

No obligation to buy any future offerings.

This remarkable $3.98 offer is brought to you by The International Preview Society—a highly selective music program that does not oblige you to buy at any time. These multi-record/cassette selections—and many, many more superb choices will continue to be offered to you every four weeks. Each offering highlights a Featured Selection . . . plus an impressive variety of alternate selections (many available on cassettes). And all are well below suggested retail!

You'll save even more through the *Society's Half-Price Bonus Plan.* For every regular member purchase you make, you may choose a Bonus—album or multi-record set—for only *half* of the members' already-low club price. *That amounts to a savings of more than 48% off the suggested retail price!* A postage and handling charge is added to all shipments.

If you'd like to receive the Featured Selection, you need do nothing. We'll send it automatically. But if you'd prefer an alternate selection or none at all, just mail back the Notification Card—enclosed with the offering—by the specified date. You'll always have at least 10 days to decide. Should you ever have less than 10 days, you will receive full credit for returned merchandise.

As Many As Four Records For Less Than The Price Of One.

You may choose any one of these sets for just $3.98 plus a small postage/handling charge. (Sales tax added for New York residents.) Remember, each set contains either three or four records (or 2 to 4 cassettes). That's a savings of as much as $39.94 . . . up to 91% off the suggested list price!

Send no money. We want you to judge for yourself before you decide to buy. If you are not delighted after ten days, return the set.

These are superior, silent-surfaced recordings by Deutsche Grammophon and Philips. They come in a handsome storage case with an informative, illustrated brochure.

Every recording offered by the Society must meet the rigid standards of the Carnegie Hall Selection Committee. Only albums of the most exceptional musical interest, artistic excellence and technical quality are offered.

So do take advantage of this marvelous value and mail in the coupon today. You'll also be reserving the opportunity to order other great international releases from the Society at impressive savings.

Johannes Brahms
4 SYMPHONIES
Vienna Philharmonic
Berlin Philharmonic
Dresden State Orc
London Symphony
CLAUDIO A

Deutsche Grammophon

PHILIPS

Also Available On Cassette

BRAHMS Four Symphonies (4 LPs) *Claudio Abbado: Vienna Philharmonic, Berlin Philharmonic, Dresden State and London Symphony Orchestras*
LPs #82; Cassettes #92

BEETHOVEN
Die Klavierkonzerte
The Piano Concertos
Les 5 Concertos pour piano
CLAUDIO ARRAU
Concertgebouw Orchestra, Amsterdam
Bernard Haitink

BEETHOVEN The Piano Concertos (4 LPs) *Claudio Arrau, Bernard Haitink: Concertgebouw Orchestra, Amsterdam*
LPs #83; Cassettes #93

TCHAIKOVSKY

TCHAIKOVSKY Symphonies 4, 5 and 6 (4 LPs) *Mravinsky: Leningrad Philharmonic, Sleeping Beauty & Swan Lake. von Karajan: Berlin Philharmonic*
LPs #84; Cassettes #94

DON GIOVANNI
KARL BÖHM

MOZART Don Giovanni (4 LPs) *Fischer-Dieskau, Flagello, Nilsson, Schreier, Arroyo, Talvela, Grist, Mariotti, Karl Böhm: Prague National Theatre Orchestra*
LPs #85; Cassettes #95

Free Home Audition Request

The International Preview Society
175 Community Drive, Great Neck, N.Y. 11025

YES! Please send me, for my free audition, the multi-record or cassette set I have indicated by the number below. I may return it after 10 days and owe nothing . . . or keep it and pay only $3.98 plus a small postage/handling charge (sales tax added for New York residents). This is up to $39.94 off the suggested retail price. I will also receive, approximately every four weeks, an offering of the finest classical recordings. Of course, I may cancel at any time.

Please print selection number here: ☐

Name

Address Apt. No.

City State Zip

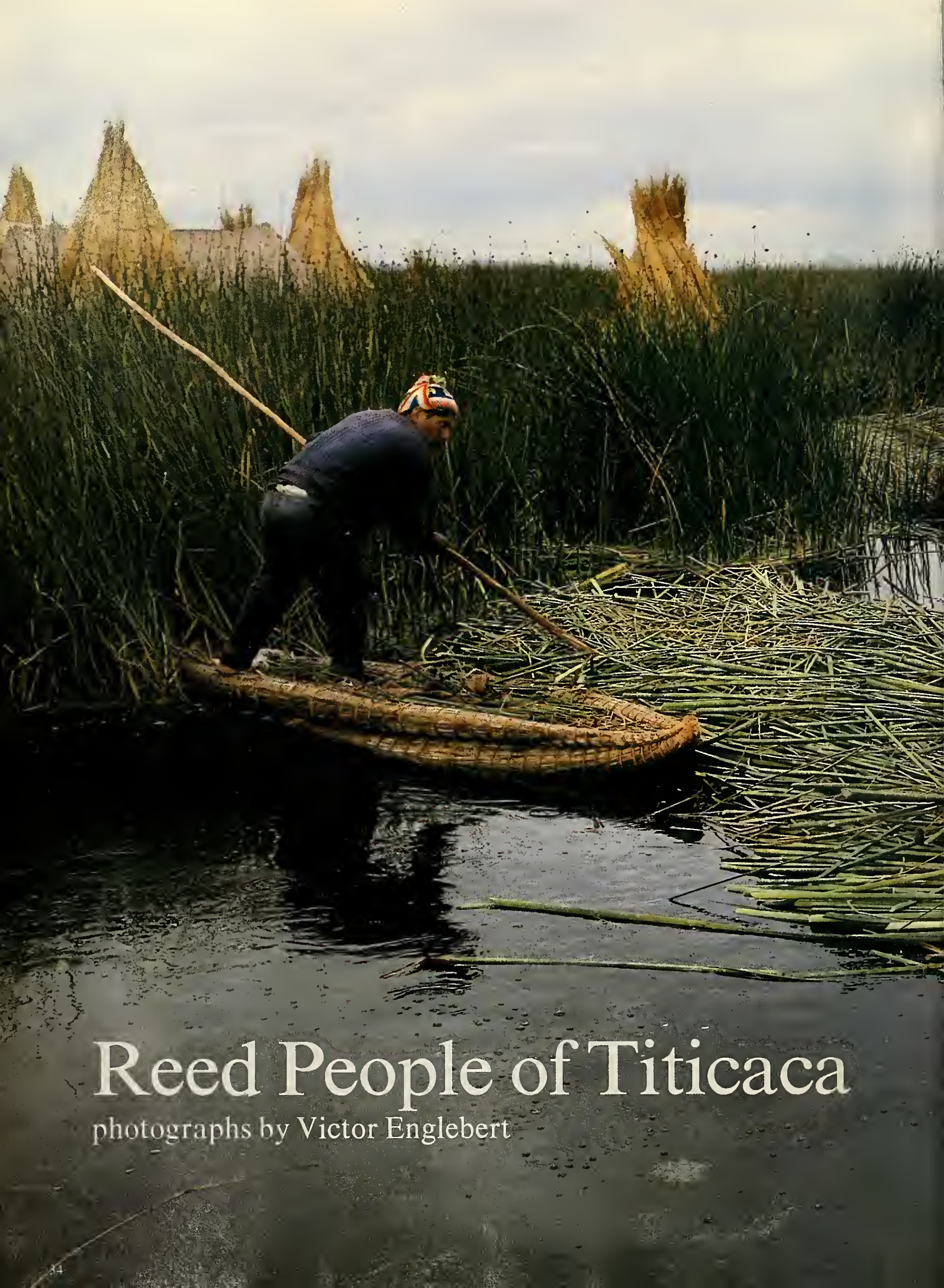
Offer limited to the connecting 48 states. Limit one membership per household. Only new members eligible. NOTE: All applications are subject to review, and we reserve the right to reject any application.

59117

TCHAIKOVSKY OVERTURE 1812

FREE BONUS

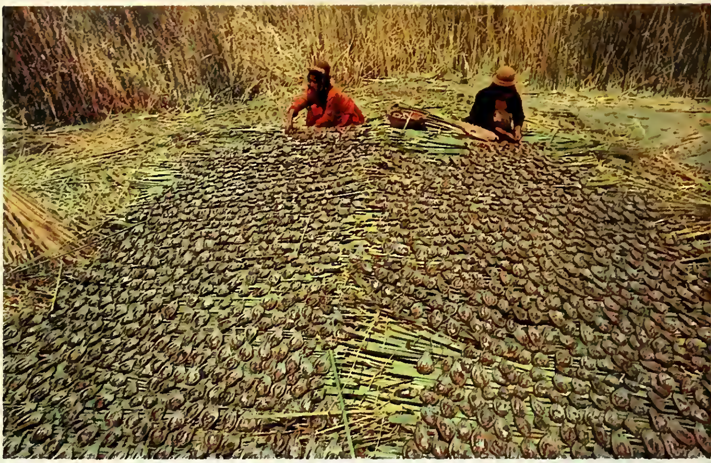
Return coupon within 10 days for valuable *free* gift — TCHAIKOVSKY's *1812 Overture,* Bernard Haitink: Concertgebouw Orchestra, Amsterdam.



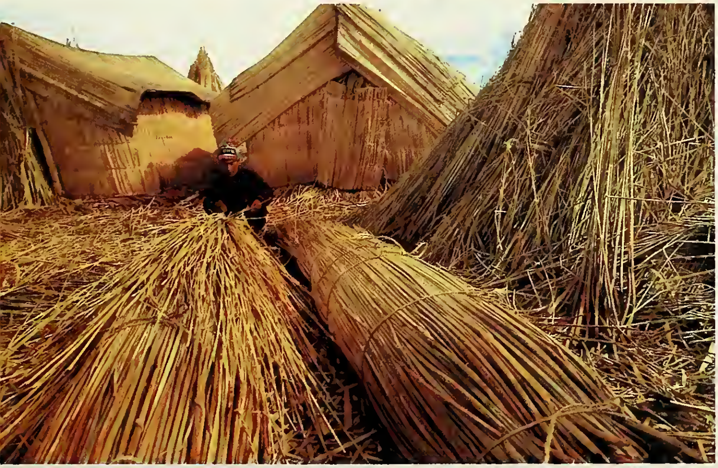
Reed People of Titicaca

photographs by Victor Englebert

The Uru Indians live on islands of reeds laid down in the marshes of Lake Titicaca. There they exploit the resources of the habitat, including fish and waterfowl. At right, fish are spread out to dry in the sun.



The totora reeds that make up the islands have other uses. Pulled up by the roots, the blanched portion of the fresh stem can be eaten raw. Dwellings are built with reed mats. Below, a man fashions a reed boat.



In the marshes of Lake Titicaca near Puno, Peru, there are people who live unobtrusively on man-made islands of totora (cattail) reeds. Although they are known as Uru Indians, probably none of them speak the Uru language or can claim pure descent from Uru ancestors. Pressured by the Incan and Spanish empires and, more recently, by natural and economic hardships, the Uru actually ceased to be a distinct people more than a generation ago, merging through intermarriage with the larger populations of Aymara- and Quechua-speaking Indians. Apart from their picturesque setting and some practical and material aspects of culture linked to it, the present-day Uru are indistinguishable from the Indians who live on dry land. Linguistic evidence shows, however, that the Uru of antiquity were related, not to their Aymara neighbors or to the Quechua-speaking Inca, but possibly to Arawakan peoples living in the tropical jungles of the Amazon. Until recent times, the Uru maintained a sense of exclusiveness, believing themselves different from the people around them. For their part, the Aymara and Inca regarded the Uru with a mixture of awe, for possessing certain alleged powers, and contempt, for what was felt to be a lowly existence (the Inca even demanded from them a tribute of lice). This ambivalence was reflected in the name Uru, which probably signified "light of day" in Aymara but which means "vermin" in Quechua. Known by other names as well, the Uru referred to themselves as the Kjotsuñi (*q'otšoñi*), from the Aymara *q'ota* ("lake") and the Uru *šoñi* ("people"). And the lake defines their identity to this day.

Hot stones are used to cook fish, left. Outsiders sometimes sink uncomfortably into the damp "ground," but the Uru are accustomed to their undulating islands. They are reputed to have a peculiar gait on dry land, however.

Traditional reed boats, below, which are built on the principle of the raft, are made by the Uru and other Indians who live by Lake Titicaca. Aymara Indians built Thor Heyerdahl's Egyptian-style papyrus craft Ra II.

A Brown Study of the Brown Pelican

This coastal bird has survived the insidious effects of DDT contamination. With its status still shaky, it must overcome other ominous threats

by Ralph W. Schreiber

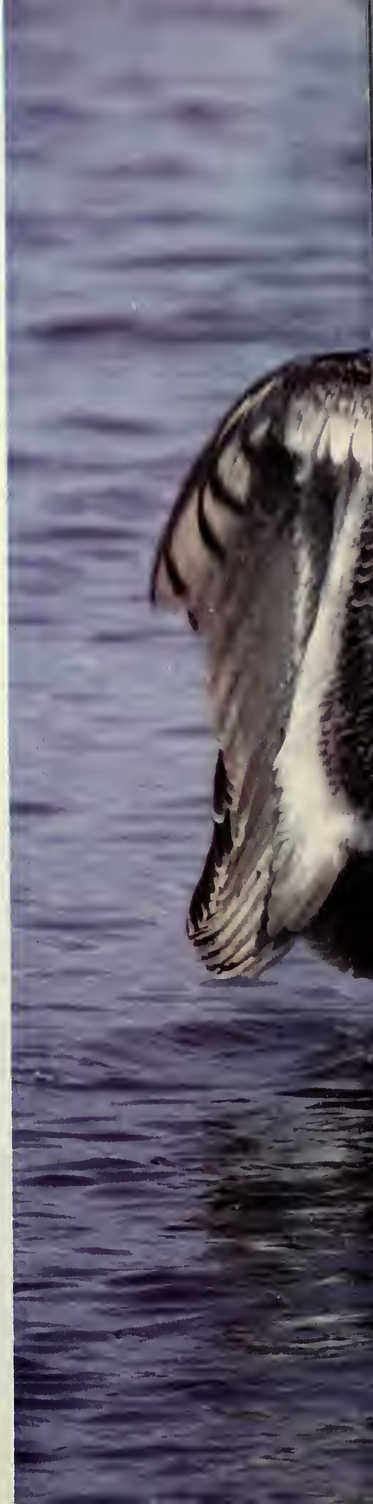
In 1973 the brown pelican was placed on the U.S. endangered species list. This ungainly creature—whose ancestors date back forty million years—had been brought to the edge of extinction in the United States by chemical contamination, principally the unrestricted use of the pesticides DDT and endrin.

On the east coast, the brown pelican nests from North Carolina through the Caribbean to Guyana; on the west coast, it nests from southern California through Mexico, Panama, Peru, Chile, and the Galápagos Islands. A decade ago the only known successful breeding colonies in the United States were in Florida. The large numbers of birds that once nested in Texas and Louisiana had disappeared almost overnight; no native pelicans nested there after the early 1960s. In California brown pelicans were laying eggs without shells or with shells so thin they were crushed on laying or by the weight of the incubating parents. Hundreds of broken eggs were scattered about breeding colonies and few young were produced. The obvious decline in population of this fascinating bird motivated public concern and unusually intensive research efforts, so that now the brown pelican is among the best-studied birds of the world.

The brown pelican (*Pelecanus occidentalis*) is one of seven species that make up the family Pelecanidae. All members of this family are known for their totipalmate feet (four toes connected by a web), long bills, and gular pouches. All pelicans eat fish, but only the brown dives from the air to capture its prey. It is also the only marine species and always nests in colonies on islands. Nests, which may be built either on the ground or in trees, are platforms of interwoven sticks topped with grass and leaves and are usually constructed just out of pecking distance of a neighboring pelican's nest site.

The birds usually do not begin breeding until they are three to five years old. Males are larger than females, but otherwise the sexes are virtually indistinguishable in appearance. Throughout the complete cycle of courtship, breeding, raising young, and molting, adults undergo striking seasonal changes in plumage; young birds show none of the bright colors of the adults. Clutch size is usually three eggs, and incubation, shared by both sexes, takes about four weeks. Breeding success varies considerably from year to year, depending primarily on the amount of fish the adult pair can catch. An adult daily consumes 20 percent of its body weight in fish, and it must provide about 125 pounds of fish to its young during the eleven- to twelve-week nestling period for successful fledging. After laboring to feed their young to fledging weight and age, the parents abandon the chicks. The young must live off their accumulated fat reserves while teaching themselves to dive for fish. Less than 30 percent of the fledglings learn to feed themselves well enough to survive their first year of independence. Those that master the complicated technique of diving for fish survive; the others do not.

The reproductive failure of brown pelicans in California during the mid-1960s prompted an investigation of the factors responsible for eggshell thinning. The results showed that eggs laid before the introduction of DDT into the environment (in about 1945) had thicker shells than eggs laid thereafter. In par-



An adult brown pelican daily consumes up to 20 percent of its weight in fish. The bird is an adept fisher, but fluctuations in fish populations can threaten the survival of pelican colonies.

Lynn M. Stone

Ralph W Schreiber

Of the seven pelican species, the brown pelican is the only one that is marine and the only one that dives from the air to capture fish. The three birds, above right, are plunging after a school of fish they have spotted in the Gulf of California, Mexico. Brown pelicans, trying to cadge a meal from mullet fishermen, top, mill around the boat as the net is hauled aboard. The birds have learned that fishermen will often toss them something from their catch. The resultant tameness of the birds can have dire consequences; birds frequently become entangled in a fishing line and perish, bottom. Almost 5 percent of Florida's brown pelicans die this way each year.

ticular, a strong correlation was discovered between residues of DDE (a metabolite of DDT) in the lipid in the eggs and the degree of eggshell thinning: more DDE meant thinner shells. Extremely high amounts of DDT wastes were being dumped into the Los Angeles sewer system by a major manufacturer of the substance.

Because of their high position in the marine food web, pelicans ingest large amounts of chemical contaminants such as DDT. The residues of these chemicals or their metabolites are stored in body fat but move into the bloodstream and tissues during periods of stress or low fish availability when fat reserves are depleted. Pelicans are particularly sensitive to the effects of DDE in causing eggshell thinning. Although the actual mechanism is not completely understood, DDE apparently blocks the transport process that moves calcium from the bloodstream through the shell gland to the eggshell. Chemical residues may also be present in the substantial fat reserves of fledglings, which are mobilized as the young birds struggle to begin feeding themselves. As a result, any chemicals that the young pelicans ingest from their fish prey become more concentrated, with serious deleterious effects on their development.

Prior to and through the 1930s, about 50,000 brown pelicans lived in Texas and Louisiana. Few data exist for the 1940s, but a decrease in population was noted in the 1950s, and pelicans disappeared completely by the early 1960s. In Texas, fewer than fifty adults were seen during the 1961 nesting season, and their numbers have become even lower since then. At first the disappearance was attributed to low temperatures, starvation, and disease. Scientific investigations begun after spectacular fish kills

occurred in the Mississippi River and delta in the 1950s and early 1960s, however, revealed that the fish had been poisoned by endrin, a pesticide first used in 1952 to control the boll weevil, bollworm, and sugarcane borer. Huge amounts of endrin had been used in the Mississippi delta region, and the pesticide is now believed to have caused the disappearance of the Gulf Coast pelicans—both by directly killing the birds and by poisoning the fish populations of the Gulf Coast and thus eliminating the birds' food supply.

The use of endrin declined sharply in the mid-1970s. Although young pelicans were transported from colonies in Florida and released in Louisiana, where they are now breeding, the long-term survival of a colony in the Pelican State is not assured. Lingering pesticide pollution may continue to keep the population from expanding.

In California, brown pelicans failed to reproduce during the late 1960s and early 1970s (the population survived only because of the birds' long life span). But after the domestic use of DDT was banned in 1972, and the pesticide was no longer being dumped into the environment, pelicans began to reproduce in reasonable numbers. Reproduction now appears to be returning to normal. In the waters surrounding Anacapa Island, historically the site of the largest and most stable brown pelican colony in California, DDE residue levels in the marine ecosystem began to decline in 1972. This decline has continued, pelican eggshell thickness has recovered, and reproductive success has improved.

The recovery of the pelicans is a major ecological accomplishment: a wild avian population responded to the removal of a source of sublethal pollution introduced by humans. DDT is still being used in other countries, however, particularly in Mexico. The brown pelican's main breeding areas along the north Pacific coast are on islands in the Gulf of California. The numbers of birds on individual islands often fluctuate widely, and productivity varies naturally in response to food availability. There is a distinct possibility that the pelicans in the Gulf of California face a threat from the use of pesticides in the increasingly agricultural western provinces of Sonora and Sinaloa in Mexico. Close monitoring of the situation in this area is needed to be sure that any population fluctuations are normal and not caused by humans.

Throughout the species range, two other major problems arising from human activity threaten the brown pelican: disturbance in nesting colonies by tourists, photographers, fishermen, and scientists; and, probably the more drastic

Lynn M Stone

Chicks are vulnerable to predation and overheating when a nesting colony is disturbed by humans, left. The crushed egg, below, is evidence of the shell-thinning that has been caused by DDT contamination.

in the long term, competition between the pelicans and fishermen for fish stocks. Any time human visitation to a colony causes adult pelicans to leave their nests, productivity is reduced: breeding behavior is interrupted, eggs and chicks are lost to the boiling sun and to predation by crows or gulls, and nestlings may wander. Nesting colonies must remain inviolate for the pelicans and other colonial species to nest successfully.

Competition with fishermen is most drastic in California, where brown pelicans seem to restrict their diet to the northern anchovy. There is great concern that humans are overharvesting this fish, which is reduced to fish meal for feeding chickens and other domestic animals. If anchovy populations are depleted, pelicans cannot maintain their populations. To sustain a continued industry and avoid overharvesting, the National Marine Fisheries Service established a fisheries management plan in 1978 for regulating the commercial anchovy catch in California. Whether this plan will actually preserve enough fish for pelicans and other fish-eating birds is now being reviewed under the Endangered Species Act.

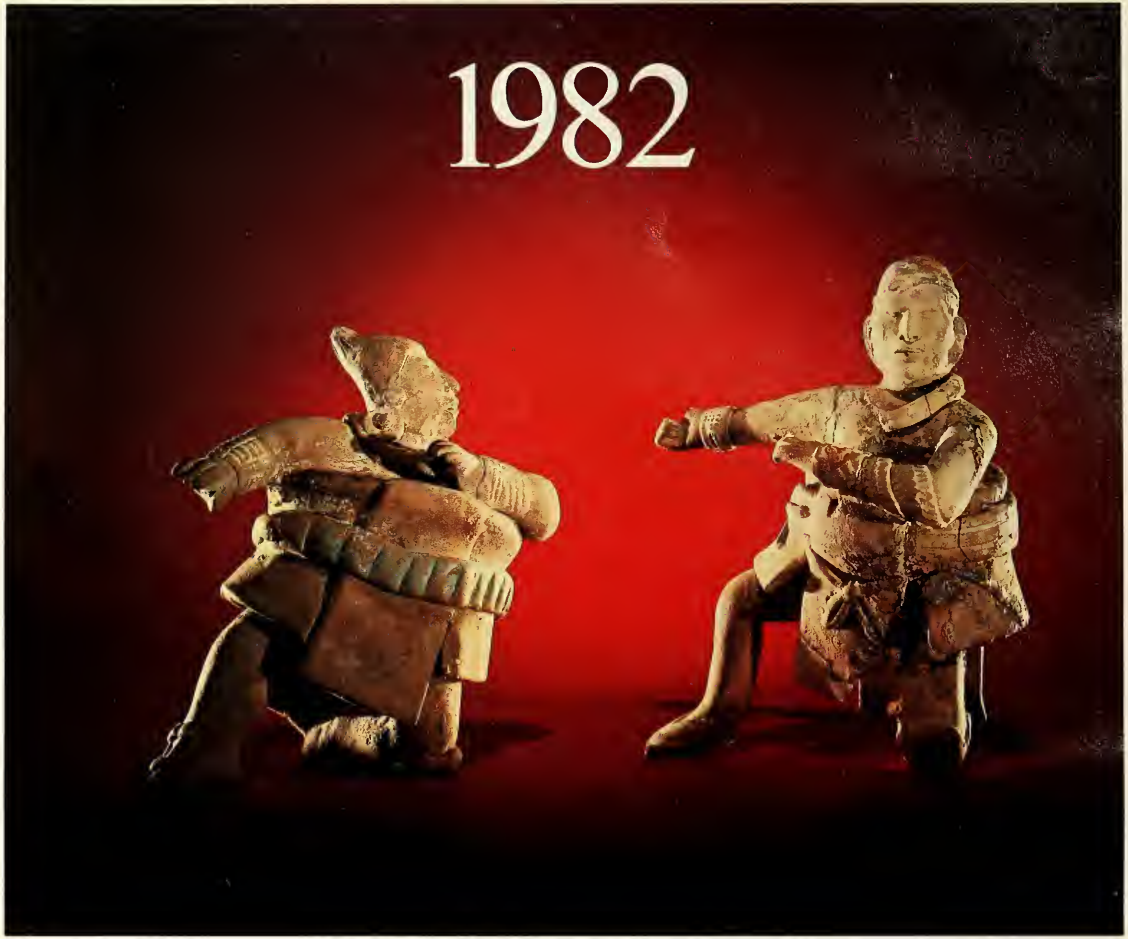
The fishery data now used to set the quota of anchovies that commercial fishermen may take are of questionable reliability. In addition, while the United States is trying to manage the resource, the Mexican fishing industry in its own waters is at present harvesting the same fish stocks in unrestricted quantities. If Mexico depletes the resource, then no matter what United States policy is, the lack of fish will severely damage the pelican population and, in fact, the whole fish-based food web.

Sport fishing also causes pelican mortality. Although the birds have learned that fishermen will often throw them a fish, they have not learned how to avoid fishing hooks and lines. Pelicans trailing fishing gear become entangled and die. More than 700 pelicans die each year in Florida alone—almost 5 percent of the total population. This is also a problem in California and other parts of their range, although it is not as severe since the pelicans are not as tame and liable to "hang around" fishermen.

The future may present other great problems for the pelicans, especially since the degradation of the oceans and estuaries continues and affects all marine life. Oil spills and dumping of bilge at sea are potential problems not only because birds may become coated with oil but also because the oil may cause a decrease in marine life productivity.

With human concern and assistance, the brown pelican has partly recovered from the pernicious effects of pesticide use. Its current increased reproductive success indicates that in all states but Louisiana and Texas the brown pelican should be removed from the list of endangered species. But such an action should not obscure the threat that pelicans and other marine birds face from the potential overharvesting of anchovies and other fishes. An argument might be made for placing the pelican on the threatened list to maintain awareness of a potential problem, especially until Mexico and the United States develop a sound, cooperative management program on the harvesting of marine resources.

In addition to adding importantly to our understanding of brown pelican biology and behavior, the studies of this bird undertaken during the past decade have documented the sublethal effects of chemicals present in our environment on avian reproductive biology. Since it is a sensitive indicator of pollution in the marine habitat that it shares with human beings, the brown pelican serves well as a monitor of the health of the seas. Perhaps our experience with this species will guide us in creating wise conservation policies, so that in the future we will be able to recognize and deal with other ecological time bombs. □



Ballplayers with protective gear. About 5 in. National Museum of Anthropology, Mexico.

Maya Figurines Terra-cotta figurines from graves on the island of Jaina, off the northwest coast of the Yucatan Peninsula, include some of the liveliest and most varied portrayals in Maya art. Some appear to represent deities or mythological characters; others, figures from daily life. These graceful and elegant miniature sculptures all date from the last half of the Middle American Classic Period (A.D. 600–900). All photographs by Lee Boltin.

Ballplayer with animal headdress. The ball, of solid rubber, was played only from the hip. 9¾ in. American Museum of Natural History.

January

SUN	MON	TUES	WED	THURS	FRI	SAT
					1 New Year's Day	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24 31	25	26	27	28	29	30

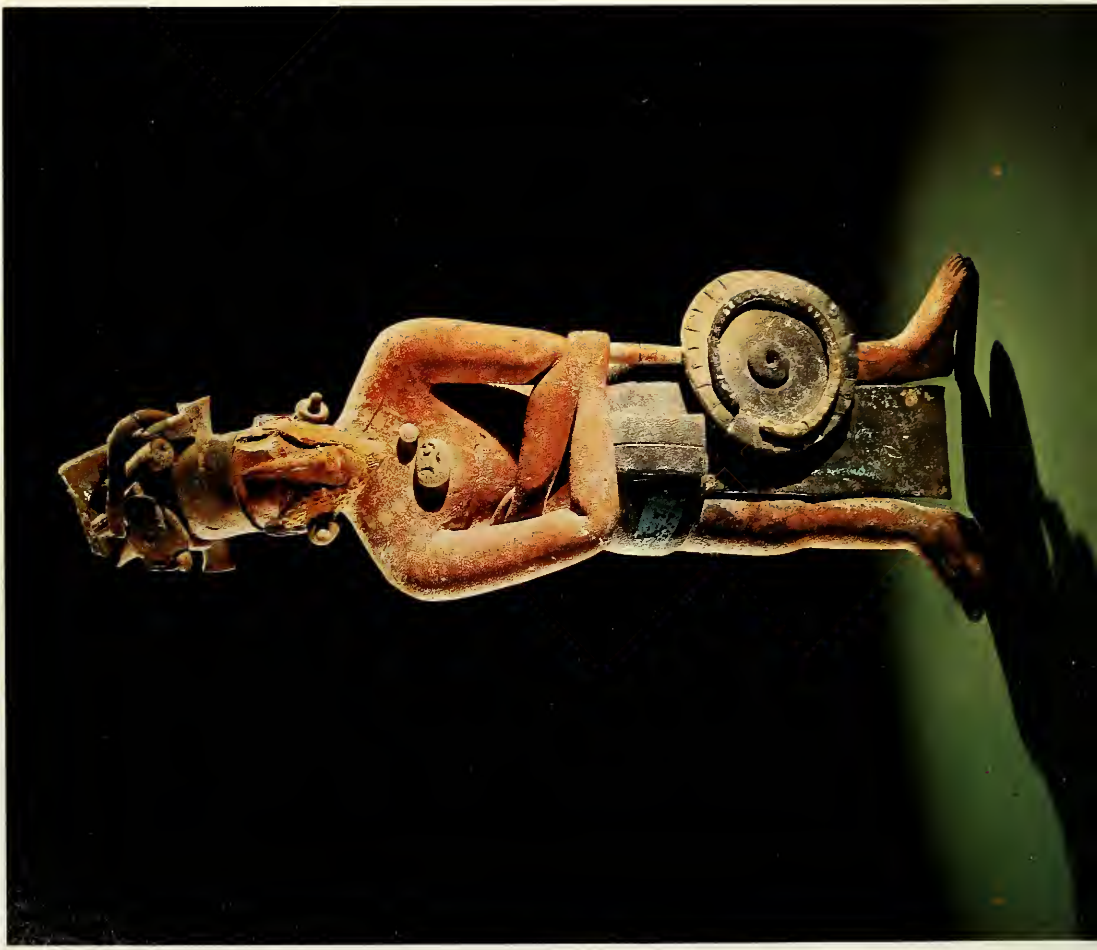
NATURAL
HISTORY
American Museum of Natural History

This female dignitary in a shawl is a very common form of Jaina figurine. About 7 in. National Museum of Anthropology, Mexico.

February

SUN	MON	TUES	WED	THURS	FRI	SAT
	1	2 Groundhog Day	3	4	5	6
7	8	9	10	11	12 Darwin's Birthday	13
14	15 Washington's Birthday	16	17	18	19	20
21	22	23	24	25	26	27
28						

NATURAL
HISTORY
American Museum of Natural History

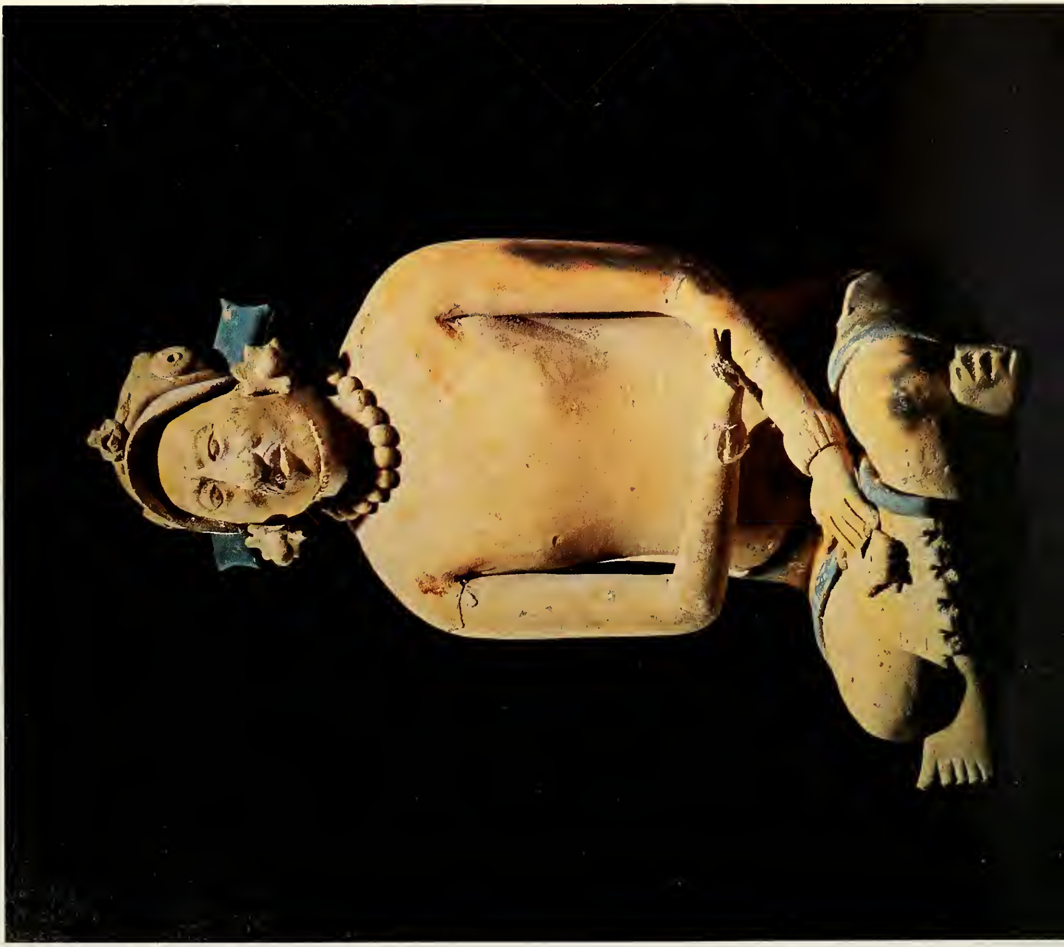


Ceremonially costumed figure, holding fan. About 7 in. National Museum of Anthropology, Mexico.

March

SUN	MON	TUES	WED	THURS	FRI	SAT
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21 Earth Day	22	23	24	25	26	27
28	29	30	31			

NATURAL
HISTORY
American Museum of Natural History



Seated man. Bead necklaces, which probably represent highly valued jade, are common on Maya figurines. About 7 in. Private collection.

April

SUN	MON	TUES	WED	THURS	FRI	SAT
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30 Arbor Day	

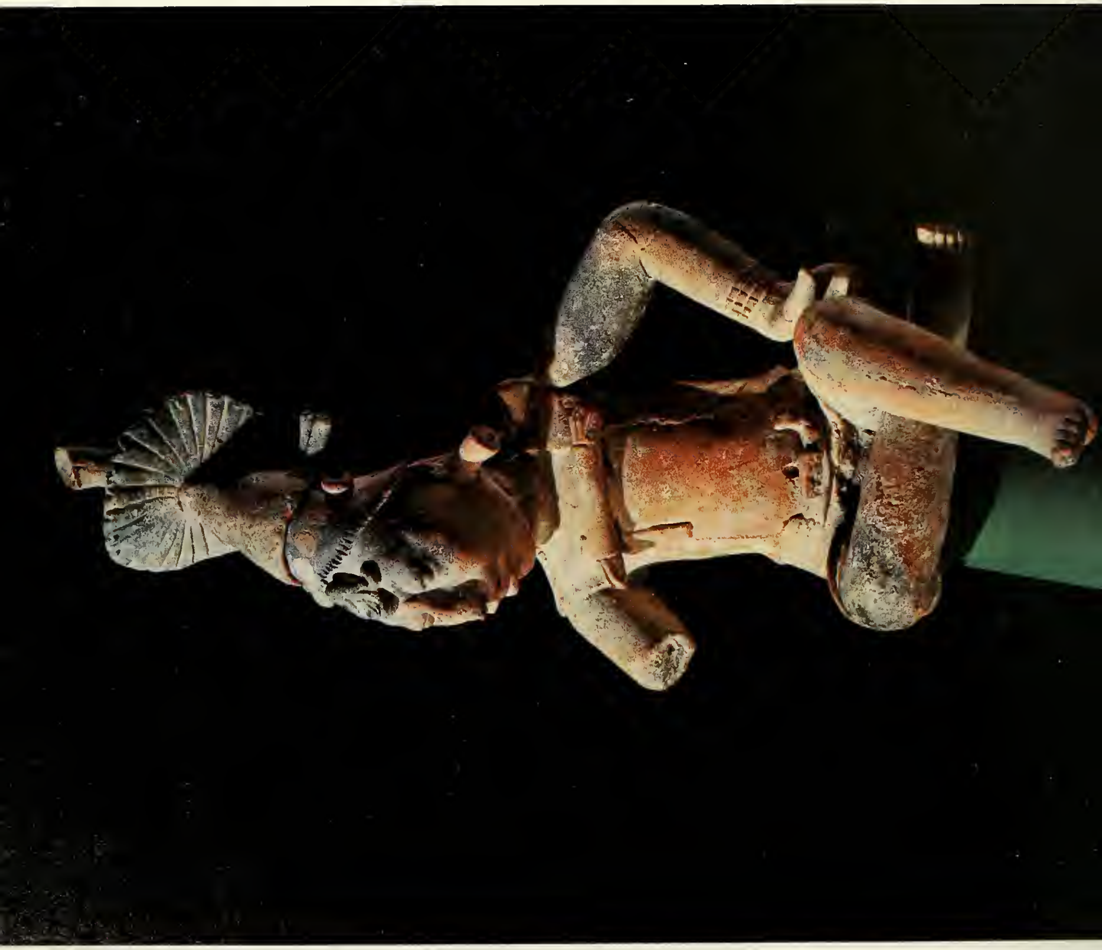
NATURAL
HISTORY
American Museum of Natural History

Like many of the figurines, this anthropomorphic rabbit with beard and earplugs is a whistle. 4¾ in. American Museum of Natural History.

May

SUN	MON	TUES	WED	THURS	FRI	SAT
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23 30	24 Memorial Day 31	25	26	27	28	29

NATURAL
HISTORY
American Museum of Natural History



Dignitary, with face highly stylized in the Maya manner. 11 [illegible] American Museum of Natural History.

June

SUN	MON	TUES	WED	THURS	FRI	SAT
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

NATURAL
HISTORY
American Museum of Natural History

Standing figure and its removable headdress. About 7 in. National Museum of Anthropology, Mexico.

July

SUN	MON	TUES	WED	THURS	FRI	SAT
				1	2	3
4 Independence Day	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

NATURAL
HISTORY
American Museum of Natural History

Ceremonially costumed figure on "throne." About 8 in. National Museum of Anthropology, Mexico.

August

SUN	MON	TUES	WED	THURS	FRI	SAT
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

NATURAL
HISTORY
American Museum of Natural History

Figure with movable arms. About 5 in. National Museum of Anthropology, Mexico.

September

SUN	MON	TUES	WED	THURS	FRI	SAT
			1	2	3	4
5	6 Labor Day	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

NATURAL
HISTORY
American Museum of Natural History

The resemblance to Christian sculpture in this female figure is purely coincidental. 5¼ in. American Museum of Natural History.

October

SUN	MON	TUES	WED	THURS	FRI	SAT
					1	2
3	4	5	6	7	8	9
10	11	12 Columbus Day	13	14	15	16
17	18	19	20	21	22	23
24 31	25	26	27	28	29	30

NATURAL
HISTORY
American Museum of Natural History

This extraordinarily active pose would seem to indicate speaking or singing. About 7 in. National Museum of Anthropology, Mexico.

November

SUN	MON	TUES	WED	THURS	FRI	SAT
	1	2	3	4	5	6
7	8	9	10	11 Veterans Day	12	13
14	15	16	17	18	19	20
21	22	23	24	25 Thanksgiving	26	27
28	29	30				

NATURAL
HISTORY
American Museum of Natural History

December

SUN	MON	TUES	WED	THURS	FRI	SAT
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25 Christmas
26	27	28	29	30	31	

NATURAL
HISTORY
American Museum of Natural History

Foundry Art

During the nineteenth century, the manufacture of cast-iron stoves flourished around Albany, New York

by Tammis Kane Groft

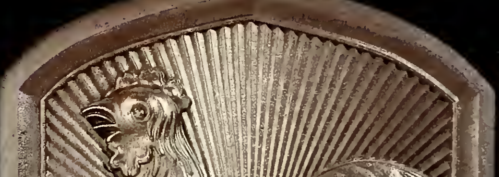
photographs by Lee Boltin

Nineteenth-century American cast-iron stoves, once prominently displayed in parlors and kitchens of Victorian homes, were relegated to barns and basements as modern central-heating systems evolved. Recent increases in fuel costs, however, have prompted renewed interest in coal- and wood-burning stoves. As museums, collectors, and the energy-conscious public reexamine the cast-iron stoves of the past, they are discovering that those manufactured in Albany and Troy, New York, during the nineteenth century best exemplify the combined achievements of American foundry and decorative arts.

Ironically, it was a wood shortage in the Northeast during the 1820s that encouraged the mass production of cast-iron stoves in the first place. Small cast-iron stoves capable of containing and radiating more heat with less wood were developed because of the inefficiency of large open fireplaces and the diminishing supply of wood due to growing consumption by factories and steamboats. Albany and Troy, located nine miles apart on opposite banks of the Hudson River, near the confluence of the Hudson and Mohawk rivers, had prospered as centers of trade and transportation since the 1700s. The combination of water and rail transportation, availability of raw materials, and local ingenuity made this area an ideal place for the development of the stove industry.

The strategic location of Albany and Troy afforded easy and inexpensive transportation of raw materials to the foundries and of finished stoves to markets throughout the world. The Hudson River provided a direct route south to New York City; the Erie Canal, opened in 1826, facilitated movement west along the Mohawk River to the Great Lakes; and the Champlain Canal provided passage north to Canada. By the mid-1850s the area was a hub for rail traffic as well.

All the raw materials needed for stovemaking were readily accessible. Iron ore, easily mined and smelted into pig iron, came mainly from nearby counties in the Hudson Valley and the Adirondacks. The limestone used as flux during the smelting process was also abundant in the surrounding counties. Coke, which fueled the furnaces, was shipped from Pennsylvania by way of the Delaware and Hudson Canal to the Hudson River. And the locally mined molding sand used in the casting



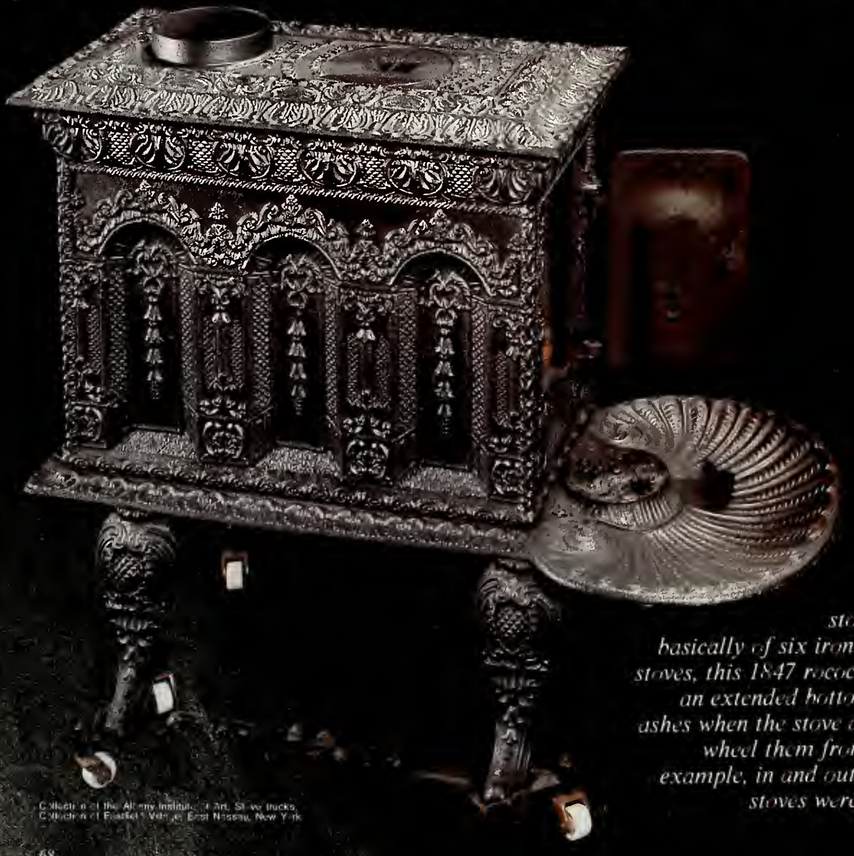
A rooster-and-sunrise motif appears on the front of the Morning Call, *an airtight parlor stove patented in 1861. Such decorations and names helped customers identify the stoves of their choice in manufacturers' catalogs.*

Collection of the Albany Institute of History and Art process—known as Albany molding sand—is even today considered to be some of the finest available in the country. The sand, sediment from a glacial lake that covered Albany between 12,000 and 15,000 years ago, has an exceptionally fine granular quality; when moistened, it retains the exact shape of a pattern, making for well-defined decorative surfaces and tight-fitting seams.

The first types of stoves made in Albany and Troy were six-plate stoves, commonly called box stoves, and so-called Franklin stoves. Benjamin Franklin had invented the Pennsylvania fireplace in 1740. Although the technological principles of his stove were improved on during the nineteenth century, the overall design remained the same. In 1816, James Wilson of Poughkeepsie, New York, patented a stove reminiscent of Franklin's and called it a Franklin stove. Thereafter, all similar stoves were known by that name. Although more efficient than fireplaces, Franklin stoves were the most inefficient and furnished the least amount of heat of all cast-iron stoves. They were not designed to be airtight, although doors were eventually included and could be closed to contain the heat. The stove design is still popular today, however, as it is always a pleasure to see the flickering flames of a wood-burning fire.

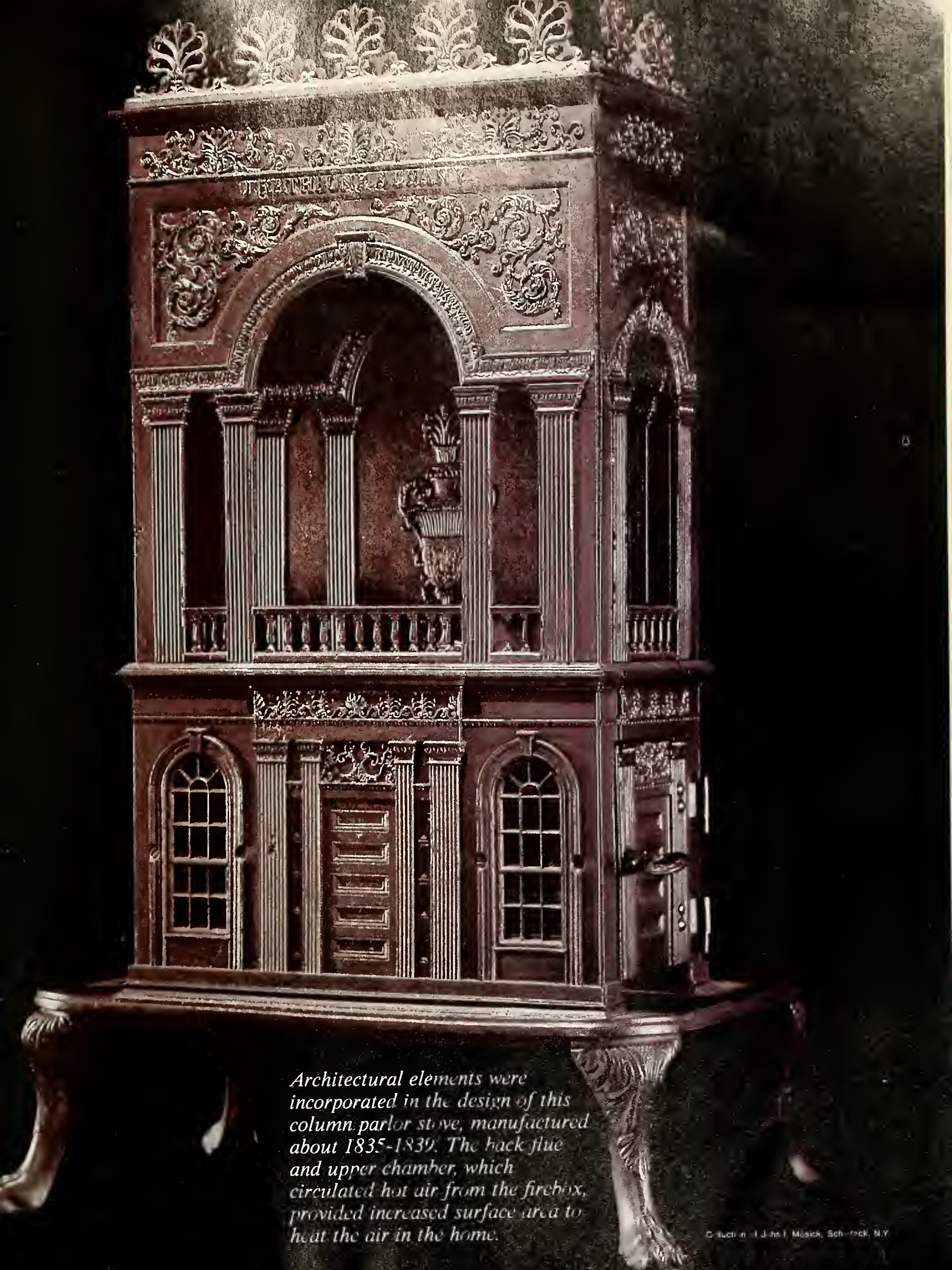
By the mid-1830s stove manufacture was a thriving industry in Albany and Troy. While the early stoves consisted of relatively flat plates decorated with delicate floral or geometric low reliefs, cast-iron stovemaking soon reached its highest artistic achievement and technological advancement. During the period from the 1840s through the 1860s, two-sided "flask" casting and the advent of the "cupola" furnace, which provided better control than a blast furnace, permitted more convoluted surfaces and finer quality casting. This improved technology accommodated the exuberant designs that were in fashion.

Three local men were responsible for notable inventions that contributed to the development of the stove industry in Albany and Troy. Eliphalet Nott, an authority on combustion fuels and for sixty-two years president of Union College in Schenectady, New York, patented one of the first



Among the wood-burning stoves popular in the nineteenth century were so-called box stoves, which consisted basically of six iron plates. Like all box stoves, this 1847 rococo revival design had an extended bottom plate to catch the ashes when the stove door was opened. To wheel them from place to place, for example, in and out of summer storage, stoves were set on stove trucks.

Collection of the Albany Institute of Art. Stove trucks, Collection of [illegible] Village, East Nassau, New York



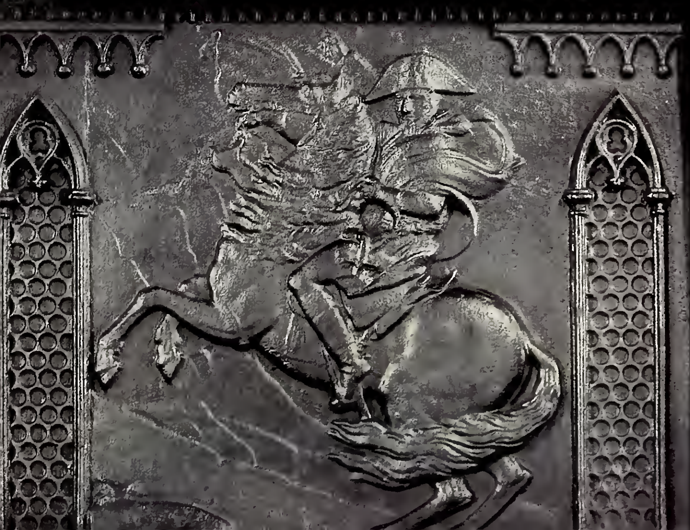
Architectural elements were incorporated in the design of this column parlor stove, manufactured about 1835-1839. The back flue and upper chamber, which circulated hot air from the firebox, provided increased surface area to heat the air in the home.

Collection of John I. Musick, Schodack, N.Y.

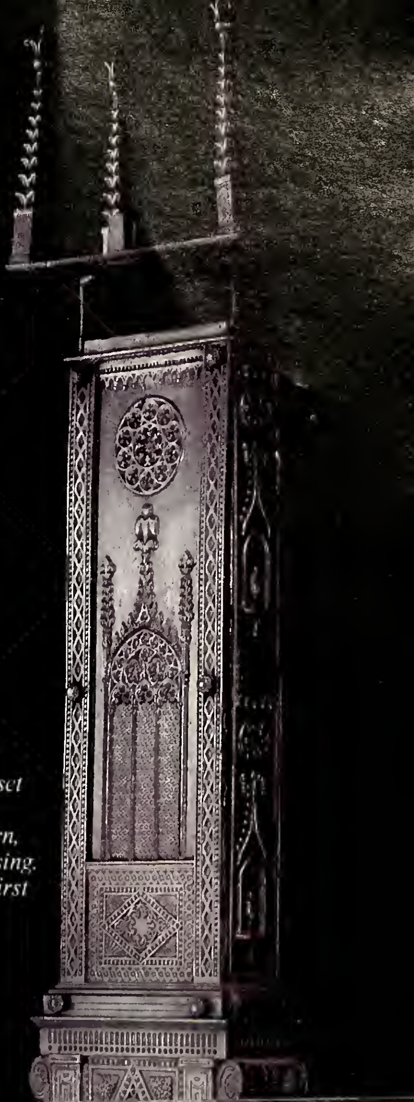
successful anthracite-burning stoves in 1832. The stove, known as Nott's Patent, revolutionized the industry because it burned anthracite, a source of energy previously untapped for domestic consumption. In 1838, Philo Penfield Stewart of Troy, founder of Oberlin College in Oberlin, Ohio, perfected one of the nineteenth century's best-known cooking stoves, with sides and base shaped so that the wood rolled to the center, thereby facilitating combustion. And in 1854, D.G. Littlefield, of Albany, patented the first successful baseburning stove, a stove into which fresh fuel is automatically fed from a hopper as the lower layer of fuel is consumed. Baseburners were considered the most powerful heaters available during the latter half of the nineteenth century.

Column parlor stoves, made during the 1840s, featured two, four, six, eight, or ten columns rising

Collection of the Albany Institute of History and Art; Gift of Mr. & Mrs. Richard C. Rockwell



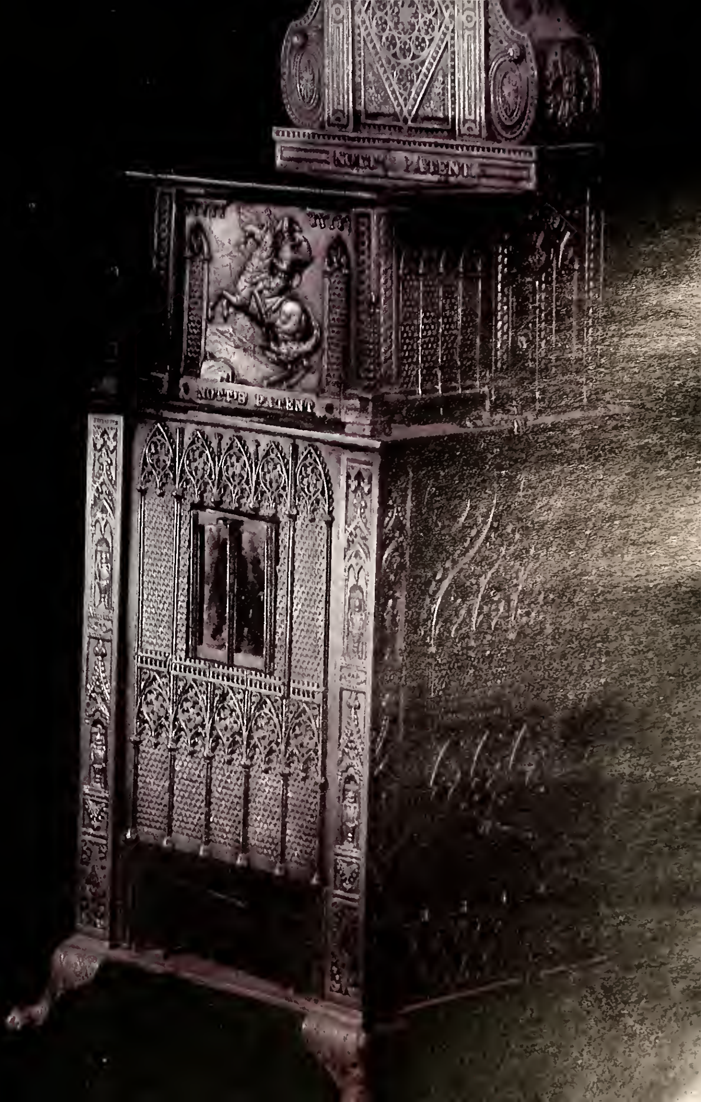
A relief of Napoleon (detail, left) decorates a large Nott's Patent stove, right, manufactured about 1832. Two mica windows that reveal the fire are set in the base of the stove, which is embellished with Gothic motifs. An urn, ashpan cover, and top cornice are missing. Nott's Patent stoves were among the first to successfully use anthracite as fuel.



out of the firebox and connected at the top by a horizontal chamber. Intended to circulate hot air for a longer period of time and increase heat radiation through additional surfaces, the distinctive form inspired many splendid variations in design. The overall shape suggested architectural motifs and easily accommodated the then current Greek, Roman, Egyptian, and rococo revival trends, as well as lavish fruit and floral ornamentation. Bowls or urns often topped the stoves and were filled with perfumed or spiced water to counteract the disagreeable smell and dryness caused by the heated iron. The intricate stove patterns were cast from carvings in mahogany or pine executed by highly skilled craftsmen who borrowed freely from manuals for architects and cabinetmakers.

Rectangular parlor stoves made during the 1850s were often advertised as airtight. The advantage of an airtight stove was that the rate of combustion was completely controlled by the damper, allowing the fuel to burn with the greatest efficiency. Many of these stoves were given romantic names, such as Venetian Parlor, Castle, and Temple Parlor, to enhance their allure and help buyers identify them when ordering from catalogs. American architecture underwent a dramatic change during this period because the efficiency and prolific use of stoves enabled houses to be built with many more rooms, larger windows, and higher ceilings.

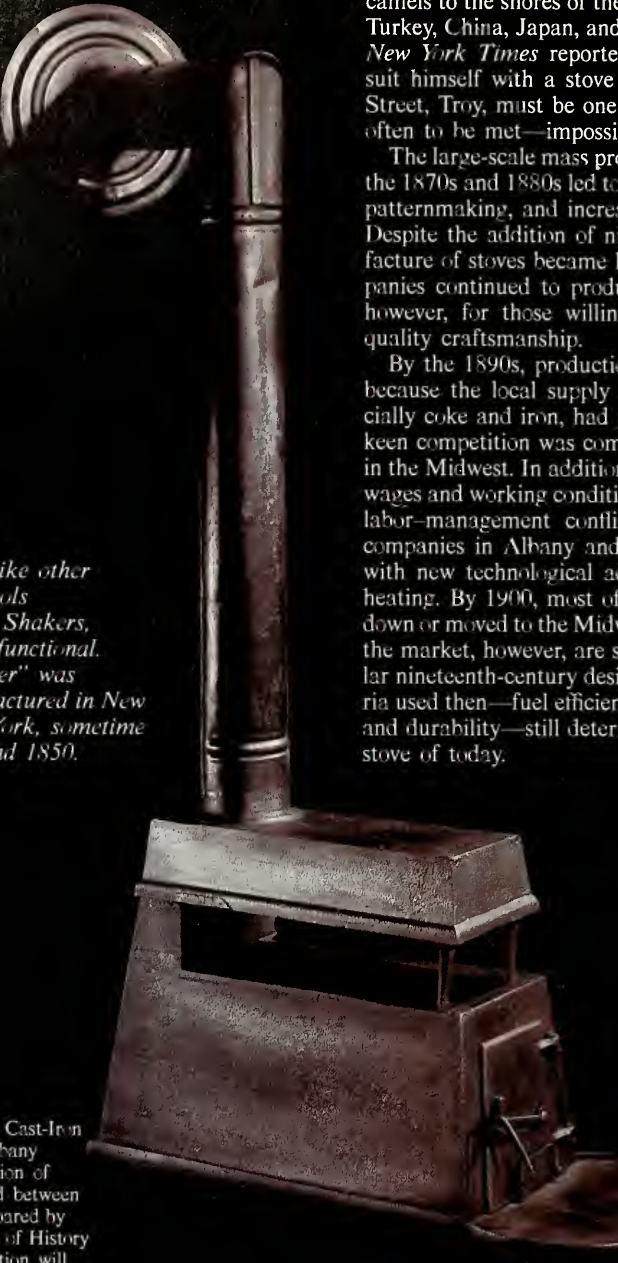
Elaborate parlor stoves, cookstoves, ranges, baseburners, and a large variety of related cookware items were manufactured in Albany and Troy in tremendous quantities during the latter half of the nineteenth century. Demonstrating the importance of the overseas trade, many of the stove catalogs, published annually, were written in English, French, and German. Of Troy stoves it was said that "llamas have carried them across the Andes to the farthest coasts of South America,



camels to the shores of the Black Sea, and ships to Turkey, China, Japan, and Australia." In 1872 the *New York Times* reported: "A man that cannot suit himself with a stove in walking along River Street, Troy, must be one of those creatures—too often to be met—impossible to please."

The large-scale mass production of stoves during the 1870s and 1880s led to simpler designs, routine patternmaking, and increased use of sheet metal. Despite the addition of nickel-plating, the manufacture of stoves became less inspired. Most companies continued to produce an "art stove" line, however, for those willing to pay the price for quality craftsmanship.

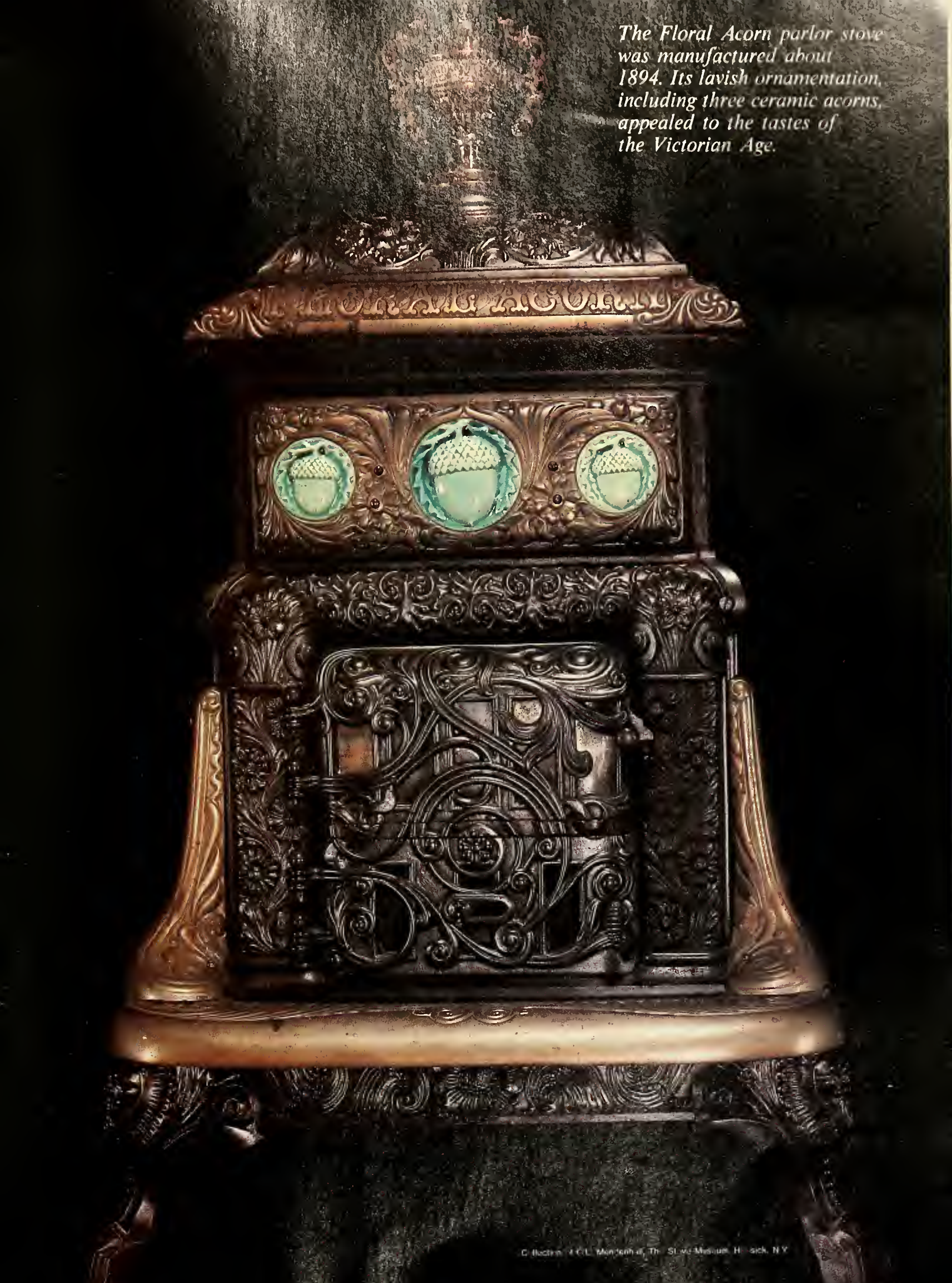
By the 1890s, production had declined sharply because the local supply of raw materials, especially coke and iron, had greatly decreased, while keen competition was coming from new foundries in the Midwest. In addition, union drives for better wages and working conditions resulted in turbulent labor–management conflicts that prevented the companies in Albany and Troy from keeping up with new technological advances in cooking and heating. By 1900, most of the foundries had shut down or moved to the Midwest. Stoves currently on the market, however, are still modeled after popular nineteenth-century designs, and the same criteria used then—fuel efficiency, proper draft control, and durability—still determine the most desirable stove of today. ☐



Shaker stoves, like other furniture and tools designed by the Shakers, were plain and functional. This "superheater" was probably manufactured in New Lebanon, New York, sometime between 1825 and 1850.

Collection of The Shaker Museum, Old Chatham, N.Y.

"Cast with Style: Nineteenth Century Cast-Iron Stoves from the Albany Area" is an exhibition of stoves manufactured between 1825 and 1925. Prepared by the Albany Institute of History and Art, the exhibition will be on view in Albany, New York, until February 7, 1982. From April 1 through June 1, the exhibition will be shown at the New-York Historical Society in New York City.



The Floral Acorn parlor stove was manufactured about 1894. Its lavish ornamentation, including three ceramic acorns, appealed to the tastes of the Victorian Age.

Collection of C. L. Mendenhall, The Stove Museum, Hoosick, N.Y.

Dam Changes on the Colorado River

Life in Grand Canyon has partly adjusted to the new river created by Glen Canyon Dam, but the future is uncertain

by Steven W. Carothers and Robert Dolan

When Frederick Law Olmsted, Jr., serving as consultant to the National Park Service, read the Bureau of Reclamation's 1946 master plan for construction of hydroelectric dams on the Colorado River, he was not alarmed. The scenic beauty of the Grand Canyon would not, in his mind, be compromised by the many dams and lakes that were scheduled to eventually appear within and adjacent to Grand Canyon National Park. The science of ecology was still young, and Olmsted's failure to predict the consequences of the altered river flow is easy to understand. If we could bring him back from the grave and tell him of the changes that have taken place in Grand Canyon as a direct result of one of these large dams—Glen Canyon—he would undoubtedly receive the news with incredulity.

In the mid-1950s, construction began on Glen Canyon Dam, just fifteen miles upstream from the present boundary of Grand Canyon National Park. The first water passed through the dam's turbines in 1963, and Lake Powell, the dam's 180-mile-long, nine-trillion-gallon reservoir, was finally filled in 1980. The water released from the dam flows for about 250 miles through Grand Canyon before reaching Lake Mead, the impoundment created in 1936 by Hoover Dam. Visually, the most striking change in the river below Glen Canyon Dam is its color. Before the dam was built, an average of 140 million tons of reddish sediment were transported through Grand Canyon each year. The color imparted by the sediment to the river was so distinctive that in 1776, when Friar Francisco Garcés and a small band of Indians broke from heavy timber and found themselves on the south rim of the great abyss, the Spanish missionary identified the river far below them as the *Río Colorado*, or Red River. Both the river and what Friar Garcés described in his journal as "the most profound canyons which ever onward continue" are still there, but an observer standing on the rim today would be more apt to name the river *El Río Verde* or *Esmeralda*, the Green or Emerald River. Most of the sediment is now being trapped on the bottom of the upstream reaches of Lake Powell, and the water released through the dam's power-producing turbines and floodgates is crystal clear. The new color of the river results primarily from the extensive proliferation of green algae on the river bottom.

Glen Canyon Dam has brought about many other alterations in the basic character of the Colorado River—alterations that have greatly influenced the entire reach of the river in Grand Canyon. These changes have recently been the subject of multidisciplinary investigations involving ecologists, geomorphologists, and park managers. The findings are conclusive: the dam has resulted in a new environment for the aquatic and terrestrial ecosystems that for millions of years developed in complex harmony with the Colorado River. Native plants and animals have either adjusted or become extinct, while some exotic species have colonized the new environment.

The research findings pose fundamental management problems for the National Park Service, the federal agency mandated to preserve and protect Grand Canyon National Park. The environment of the predam Colorado River no longer exists, and the park service is left with a confusing mixture of native and exotic animal and plant species that are still adjusting to the changes. Furthermore, the future of the new environment is uncertain. The Colorado River in Grand Canyon—more than 250 miles of white water flowing through a mile-deep chasm—will always be attractive to those in the business of impounding large bodies of

A boatload of river runners approaches Grand Canyon National Park's Badger Rapid, left. When not churned by white water, the Colorado River generally appears green. Reddish sediment that used to be carried through the canyon is now trapped by Glen Canyon Dam, and the clear water allows the growth of green algae on the river bottom. Occasionally, sediment produced by floods in one of its tributaries will temporarily turn the river red, right.

Josef Muench

John Running

freshwater and producing electrical energy. National parks are usually protected from such development, yet two other dams proposed for inclusion within Grand Canyon National Park have been on the drawing boards of engineers for many years. Plans for these structures—Marble Canyon and Hualapai dams—are being held in abeyance for now, but one need only visit the selected dam sites and witness the extensive tunnelings and road-building scars left by the prospective dam builders to be convinced of the area's vulnerability.

Additional dams may not present an immediate threat to the park, but recent events have made it clear that changes in the operation of Glen Canyon Dam could cause further degradation within Grand Canyon. As late as October 1981, the Department of the Interior's Bureau of Reclamation (the agency responsible for development of water resources) finally gave in to overwhelming public opposition to proposed changes in water-release schedules and structural modifications in the dam. The new plan, known simply as peaking power, would have maximized the hydroelectric potential of the dam while compromising certain recreational and ecological values in the downstream environments. Although it constituted nothing more dramatic than how, when, and how much water would be released from Glen Canyon Dam, the proposal would have resulted in significant changes in the aquatic and terrestrial habitats of Grand Canyon National Park.

Peaking power will be postponed until the water and energy demands of the Southwest are considered to outweigh the preservationists' arguments for maintaining the Grand Canyon wilderness as it now exists. There is little doubt that the plan, and any other proposed changes for the Colorado River in Grand Canyon, will continue to be controversial. To fully understand the controversy and also the possible impact of future proposals, it is necessary to understand the potential result of the changes. Any attempt to predict or assess the environmental effects of further alterations in the system, however, must take into account the history of the river before and after Glen Canyon Dam.

In all large rivers, three basic characteristics define the environmental boundaries within which associated plant and animal communities must survive: the degree of annual variation in water discharge, the continued erosion and redeposition of sediments, and the cyclic fluctuations in water temperature. Redefine these natural perturbations in a river's character and a new set of organisms soon becomes dominant, while the established organisms decline. This has been the case in Grand Canyon, where seasonal variations in water flow, temperature, and sediment transport in the Colorado River have been eliminated. Construction of Glen Canyon Dam has created a river that has no similarity to the torrent seen by Friar Garcés.

Before the dam was built, the river's discharge pattern through Grand Canyon was characterized by low flows during fall and winter and by exceptionally high spring and summer floods with an average volume of water at least twenty times that of the winter flow passing through the channel. The lowest flow ever recorded at U.S. Geological Survey gauging stations in the inner canyon was

The Colorado River in Grand Canyon is dramatically different from the river that over millions of years cut a chasm more than a mile deep. Changes in the river have been accompanied by changes in the adjacent terrestrial habitat. In response to greatly reduced flooding, vegetation has proliferated along the riverbank. In 1872, for example, when J.W. Powell visited a point about thirty miles south of Lees Ferry, his boat, the Emma Dean, *was tied to a shore devoid of plants, right. One hundred years later, a pontoon boat floating in the same spot is nearly hidden by shrubs and a tamarisk tree, far right. Many animals, such as the collared lizard, below, have also colonized the new habitat.*

U.S. Geological Survey

Bob and Clara Calhoun; Bruce Coleman

700 cubic feet per second in December of 1924. The highest flow recorded at the stations was 127,000 cubic feet per second in July of 1927. Prior to the establishment of the inner-canyon gauging stations, a flood of 300,000 cubic feet per second, recorded in July of 1884, left high-water marks along the river channel near Lees Ferry (the present eastern boundary of Grand Canyon National Park).

During these predam floods, the river overflowed its banks and created backwater and marshlike areas, habitats known to be critical breeding areas for native fishes and other organisms. These habitats are no longer being created because present water releases do not follow the natural low/high discharge pattern, which varied with seasonal precipitation and temperature change, and the previous extreme low and high flows are never reached. The amount of water flowing through the Colorado River corridor of Grand Canyon at present, and the frequency with which the releases occur, are influenced far more by economics and politics than by the climatic regimen of the drainage basin.

The primary justification for damming the river in the first place was that it would give several western states a means to comply with the terms of the 1922 Colorado River Compact. This compact was a legislated accord whereby the upper basin states of Colorado, New Mexico, Utah, and Wyoming agreed not to deplete the flow of the river at Lees Ferry below a total of 75 million acre-feet for any period of ten consecutive years. The delivery schedule for supplying the lower basin states of Arizona, California, and Nevada with their average of 7.5 million acre-feet of water per year is regulated by the production of electrical energy. Water-release schedules from Glen Canyon Dam are related directly to the daily energy needs in the major cities of the upper and lower basin states. Patterns of power demand are closely correlated with the 8:00 A.M. to 5:00 P.M. workday, and the daily fluctuations in power production are sufficient to create a freshwater intertidal zone in Grand Canyon.

Along with the altered water flow have come drastic changes in sediment concentrations in the river. Averaging 140 million tons per year, sediment transport before the dam varied from 50 to 500 million tons, with periods of deposition along the riverbed and banks within the canyon alternating with periods of erosion. At times, the river was a raging torrent capable of moving millions of tons of sand, gravel, and huge boulders in a single day. In early 1948, scientists from the U.S. Geological Survey measured 9.5 million tons of solid material carried past Lees Ferry in twenty-four hours—enough to have filled nineteen million pickup trucks to the brim. Now the pattern is a slow but deliberate erosion of the beaches along the river, with little addition of new sediment. Currently, only 20 million tons moves through the system each year, and most of that comes from undammed tributaries. The long-term effect of the changed sediment regimen is that the bottom and banks of the river channel will eventually be scoured free of sand and silt, leaving only the larger boulders, gravel, and cobbles.

Prior to the construction of the dam,

Charlie Ott, Photo Researchers

The riparian forest that has developed along the dammed, partly tamed Colorado River ranges in width from one to several meters. For the house finch, left, and other small birds, this is wide enough to support a breeding population. Larger, carnivorous animals may be less able to take advantage of the new environment, even though for some, such as the gray fox, below, their prey may now be more abundant. The band of vegetation is probably too narrow to satisfy their breeding requirements.

John Running

sunlight penetrated only an inch or so of the thick and muddy Colorado River. With the sediment removed, the sun's energy now reaches the bottom of the river. Combine this with a dramatic change in river-bottom substrate, and perfect conditions are established for the production of great quantities of the green alga *Cladophora.* In some areas, especially within the first thirty miles of the river below the dam, *Cladophora* forms dense mats over the entire river bottom. Unfortunately, few of the river's native species of aquatic vertebrates utilize this energy source to any great extent.

Although the effects of changes in the flow and sediment concentrations of the Colorado are dramatic, the new temperature regimen has probably had the most significant effect on the aquatic ecology of Grand Canyon. Before the dam was built, there was a wide range in water temperature. Winter lows ranged from just above freezing to 40°F; temperatures gradually warmed to 60° or 70° during early spring and finally reached 75° to 85° as the annual floods subsided during July and August. The water that now flows into Grand Canyon is drawn from an area 200 feet below the surface of Lake Powell and is released through power-producing turbines located 500 feet below the surface. This area of the lake, known as the hypolimnion, is so deep that the warming wavelengths of sunlight cannot penetrate, and its water remains perpetually cold. Summer and winter, the temperature of water released from the dam is 45°. The river temperature in the dam-influenced environment increases by only one to two degrees in winter and by five to six degrees in summer, so there is now an annual temperature range of six degrees compared with as much as fifty degrees before construction of the dam.

Many of the native aquatic organisms, from fish to diatoms, were genetically prepared to begin their reproductive attempts in response to seasonally warming water temperatures. Of the Colorado River's eight known native fish species, only three—the bluehead sucker (*Catostomus discobolus*), the flannelmouth sucker (*C. latipinnis*), and the speckled dace (*Rhinichthys osculus*)—are still represented by what appear to be healthy, reproducing populations throughout most of their predam canyon range. All available evidence, however, indicates that these three species cannot reproduce in the cold water of the main river channel—the young are found only in canyon sidestreams in which pristine conditions still exist.

Three other native species—the bonytail chub (*Gila elegans*), roundtail chub (*G. robusta*), and Colorado River squawfish (*Ptychocheilus lucius*)—are extinct in the system. A fourth, the razorback sucker (*Xyrauchen texanus*), was thought to be extinct in the Grand Canyon until our research team captured three adults in 1977. It is unlikely, however, that the razorback suckers will survive in the Grand Canyon, and the recent razorback sightings probably reflect a fortuitous encounter with a fish on its way to extinction. Another native, the humpback chub (*G. cypha*), is apparently now restricted to a breeding habitat at the mouth of, and extending a short distance up, the Little Colorado River, an area that encompasses no more than eight miles of river habitat.

The humpback chub, the bonytail chub, and the squawfish are now listed by the U.S. Fish and Wildlife Service as threatened or endangered species. Although the roundtail chub is extinct in Grand Canyon and the razorback sucker is almost extinct, these species are still represented by viable populations in other parts of the Colorado River basin, and so they are not on the federal endangered list. For the remaining native fishes in Grand Canyon, surviving the future is dependent on the continued existence of their last breeding habitats—the unaltered flowing tributaries. It is now apparent that none of the eight original species could functionally reproduce in the dam-regulated mainstream Colorado River.

Unlike the native fishes, introduced species appear to be doing well: nineteen have now been recorded within the system. Most of the exotic species could not have survived in the predam Colorado River, but many, especially the carp (*Cyprinus carpio*), catfish, several species of trout, and some minnows find the new river quite hospitable. Competition with exotics for space and food is an additional threat to the survival of the few remaining native species.

Some exotic species, such as carp, the ubiquitous invader from Asia, readily utilize *Cladophora* directly as a major food source. *Cladophora* is also indirectly responsible for making the Grand Canyon trout fishery probably the best in North America. The algae provide perfect habitat and food for microscopic diatoms and for *Gammarus*, an introduced shrimplike amphipod. This small crustacean is remarkable for its ability to achieve maximum reproductive rates under conditions of thermal constancy—a perfect preadaptation to a dam-regulated system with little variation in temperature. It is also noteworthy as trout food and is the primary source of food for the trout fishery that has developed since the dam created cold and clear water flows in the main river. *Gammarus*, also a native of Asia, was first introduced into some of the clear-flowing tributaries of the inner Grand Canyon during the 1930s in an attempt to "improve" the park by fostering the production of such edible fish species as rainbow trout (*Salmo gairdneri*). Before the dam, the crustaceans were unable to survive in the main stem river and reached significant numbers only in tributaries with permanently clear water. Now, they thrive in the main river. As a result of this simple but prolific food web, experienced anglers not uncommonly take seven- to fifteen-pound rainbows, and the record now stands at a whopping nineteen pound fish. These fish look more like spawning sea salmon than typical rainbow trout.

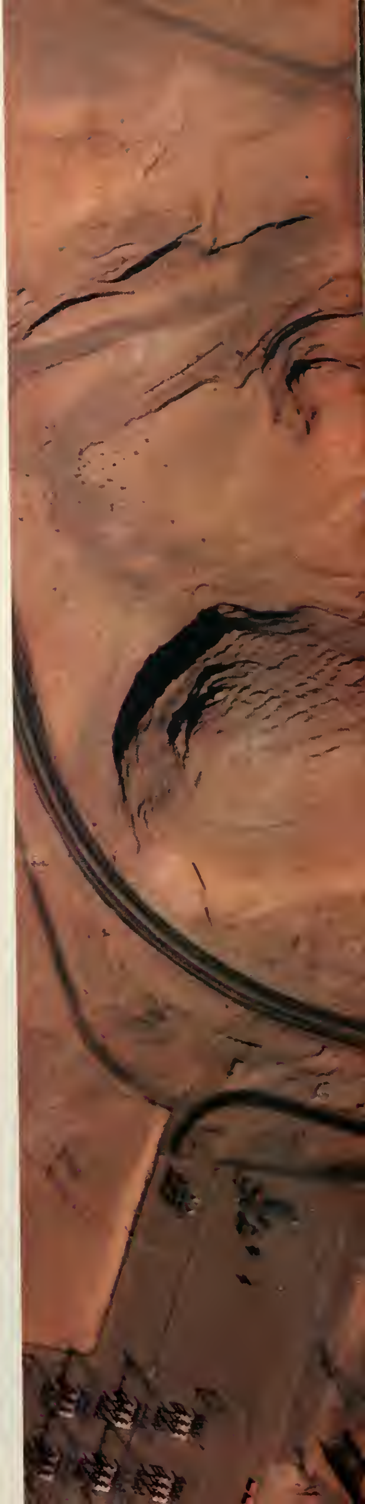
In contrast to the simplified postdam aquatic ecosystem—now dominated primarily by one species of macroscopic alga, one species of crustacean, and a few, mostly exotic, fish species—the terrestrial habitats immediately adjacent to the river have become ecologically more diverse since the dam was built. Maximum river flows are now less than one-third those of predam times, and the streamside vegetation has been adjusting to a new set of controlling factors. With the threat of annual scouring gone, woody plants that were unable to withstand yearly inundation or to grow on an unstable substrate have colonized the previously inhospitable riverbanks. Vegetation typical of the predam high-water zones, such as mesquite (*Prosopis juliflora*), cat's-claw acacia (*Acacia greggii*), and Apache plume (*Fallugia paradoxa*), continues to endure and in some areas has been creeping downslope toward the river. And plant species known for their ability to grow rapidly on moist streamside soils, such as native willows (*Salix* spp.) and the introduced salt cedar, or tamarisk (*Tamarix chinensis*), have contributed to the formation of dense thickets.

Raymond Turner and Martin Karpiscak of the U.S. Geological Survey compared predam riverbank photographs, taken on some of the earliest river expeditions, with present-day images of the same locations. In a few words, they summarized the extent of change in vegetative conditions along the river: "We believe that in the short period of 13 years the zone of postdam fluvial deposits has been transformed from a barren skirt on both sides of the river to a dynamic double strip of vegetation." This dynamic strip of woody, perennial vegetation occurs from the dam to Lake Mead and varies in width from one to several meters depending upon local relief and rock type. The species composition of this riparian forest is a mixture of native and exotic species that have not yet reached an equilibrium, or climax, condition.

The increase in plant species and biomass has resulted in rapid colonization by animal species that were previously either unknown in Grand Canyon or present in apparently far smaller numbers than they are now. Rodents, reptiles, amphibians, and small birds now abound in a developing streamside forest where previously there was bare ground. This new riparian habitat is no replacement for the hundreds of thousands of acres that now lie under Lake Powell, but it is an unanticipated benefit. Bell's vireos (*Vireo bellii*), yellow-breasted chats (*Icteria virens*), Lucy's (*Vermivora luciae*) and yellow (*Dendroica petechia*) warblers, house finches (*Carpodacus mexicanus*), indigo (*Passerina cyanea*) and Lazuli (*P. amoena*) buntings, blue grosbeaks (*Guiraca caerulea*), and at least four species of native mice, have all benefited from a substantial increase in their breeding habitats along the banks of the Colorado River.

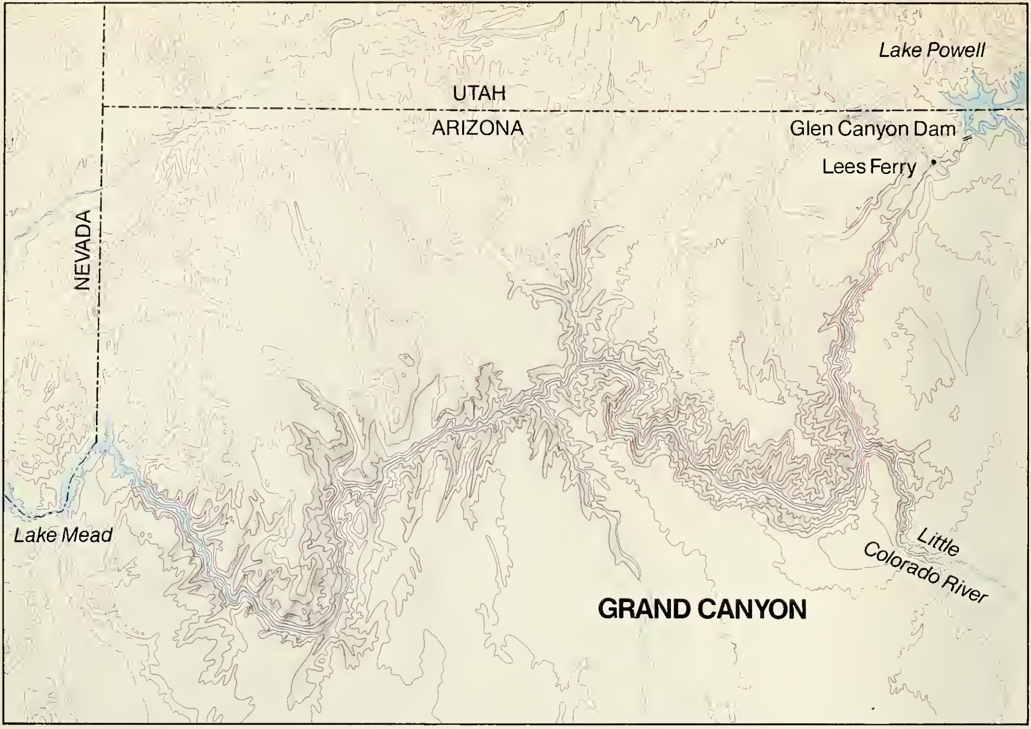
Before the variable flows were stabilized, beavers were present in the system, but their food supply in the main river was limited and the annual floods surely posed a serious threat to their survival. Now, with food abundant and floods all but gone, the beavers are enjoying a made-to-order habitat. There is no population-density information on the animal before 1961, but today almost every beach has its family of beavers. In addition, lizards, such as the desert spiny (*Sceloporus magister*), side-blotched (*Uta stansburiana*), collared (*Crotaphytus collaris*), and whiptail (*Cnemidophorus* spp.), have increased in number. Interestingly, the

Lake Powell, 180 miles long and hundreds of feet deep, lies upstream of 710-foot-high Glen Canyon Dam. Below the dam, the Colorado River still flows, but it is cold, clear, and forever changed.



Gary Ladd, Photo Researchers

Andrew Tomko



From Glen Canyon Dam, the Colorado River travels 250 miles through Grand Canyon before reaching its next obstacle, Hoover Dam's Lake Mead.

whiptail lizards, usually restricted to a desert domain, now forage at the water's edge for a new food source—amphipods stranded at low tide.

The eventual fate of the developing forest and its inhabitants is unknown. Without the annual floods carrying nutrients to recharge soils, can the now proliferating vegetation last? Will the whiptail come to depend on the amphipod and speciate accordingly? Will the canyon become a protective haven for Bell's vireo, known to be declining in numbers for lack of habitat in other parts of its range?

At the same time that they were formulating these questions, however, scientists were also becoming aware that relatively small changes in water-release patterns from Glen Canyon Dam could so thoroughly change the river as to render scientific inquiries moot. The recent peaking power proposal is an excellent case in point.

The peaking power plan was—and will be in the future if it is revived—dictated by energy needs and economic efficiency. Under such a plan, water would be released during power production and absolute minimum flows would exist when electricity was not in demand. In the river channel, the daily high and low discharge levels could be as great as 40,000 and as little as 1,000 cubic feet per second, respectively. (In contrast, for the past seventeen years the daily high- and low-water releases have averaged about 20,000 and 5,000 cubic feet per second, respectively.) Power production could last from one to several hours and occur many times during a twenty-four-hour period.

At the maximum discharge capacity of 40,000 cubic feet per second, peaking power would increase flows by 30 percent over the present high levels. To maintain a median discharge level that would not deplete the reservoir, sustained low flows would be necessary to compensate for greater water loss at periods of high power production. In short, the river would be either very high or very low or rapidly fluctuating from one extreme to the other.

The potential impacts of peaking power are, for the most part, associated with the 30 percent increase in high water. Much of the vegetation that has flourished at the water's edge for the last seventeen years would be inundated at high flows. What proportion of the riparian vegetation would survive the high water has been a point of debate. In any case, increases in the present high-water releases from the dam would certainly cause further erosion of beach sediments. As the sand disappears, so will the vegetation that is home for the many animals that have colonized the riparian forest.

For the endangered humpback chub, an increase in the power-production capacity of the dam might not be the last straw, but further habitat alterations would certainly occur. Because of the original dam-related changes in their riverine habitats, the chubs have moved into the restricted area where conditions favorable for their reproduction still exist. Portions of this refuge would be inundated if water-release levels reached 40,000 cubic feet per second. The continual inundation of the chub breeding habitat would have two potentially deleterious effects, both related to the cold water of the main stem of the river. At present, the water temperature at the mouth of the Little Colorado River is always twenty degrees or more warmer than the main stem. This temperature differential is apparently sufficient to keep typically cold-water, piscivorous (fish-eating) exotic fish—namely, the trout—out of the chub habitat. Equally important, chub require the relatively warm water to rear their young. Fishery biologists are attempting to gather data that will resolve the questions relating to ultimate humpback chub survival in the regulated system with or without future changes. In the meantime, our research team has successfully airlifted breeding adult chub from their canyon home to a Fish and Wildlife Service fish hatchery where propagation efforts are under way—just in case.

Proposed changes in the operation of Glen Canyon Dam also upset the people who believe float trips down the Colorado would be jeopardized. In 1950, only 200 people were known to have made the river run through the canyon. Since that time, more than 200,000 have made the trip. Now, river runners must usually book charters months in advance. Most of the rapid growth in the popularity of the trip took place in the postdam environment, once water levels became predictable and manageable. By the early seventies, river traffic had become so heavy that the environment, and the wilderness experience, were being degraded. In 1973, the National Park Service introduced a strict permit system, holding the upper limit to about 12,000 river runners per year.

The peaking-power release schedules would have presented white-water enthusiasts with a very different river and could have affected efforts to control river traffic. Below about 5,000 cubic feet per second, navigating between the boulders and standing waves of the river becomes exceedingly difficult; below 3,000 cubic feet per second, the larger pontoon boats cannot get through many rapids; and below 2,000 cubic feet per second, commercial trips are virtually out of the question. Releases of 40,000 cubic feet per second would also cause problems. The high water would periodically inundate approximately one-third of the currently used campsites, many in areas where there is already significant competition for camps. Ironically, commercial interests have recently convinced the National Park Service to raise the limit on the number of people allowed on the river each year, thereby increasing the demand for campsites by about 40 percent.

No one would claim that the dam should be operated according to the needs of the river runners. The job of the Bureau of Reclamation is to provide water and power; the job of the National Park Service is to protect the environment. Nevertheless, the hundreds of thousands of people who have made the trip through the canyon have also come to care for the preservation of its environment, and their concerns will always be part of any controversy over changes in the dam.

Everyone agrees that the major environmental change in the Colorado River in Grand Canyon happened as a result of the construction of Glen Canyon Dam. The disagreement arises over what to do with what is left. The system is partly stabilized, vegetation and wildlife are adjusting to the new regime, and recreation is flourishing. Since the predam Colorado River cannot be realistically restored, the National Park Service has little choice but to manage the dam-created environment for its present attributes.

The recent controversy over peaking power made it obvious that alterations in Glen Canyon Dam could result in the creation of yet another new river in Grand Canyon. The peaking power proposal has been withdrawn, but how long will the reprieve last? One thing is certain. The inevitable march of progress will come to Grand Canyon again, and the question will continue to arise: What can the National Park Service, steward of our natural areas, do to combat damaging use of park resources? Little, it seems, when the source of the damage—in this case Glen Canyon Dam—is situated outside park boundaries.

Today, however, a cautious celebration is in order. The recent debate over peaking power had all the classic markings of a determined battle between sister agencies in the Department of the Interior. Hanging on the resolution of the conflict was a determination of just who has the final authority to manage the natural resources of Grand Canyon. In this instance, public opposition to the Bureau of Reclamation gave the National Park Service the support needed to emerge the victor. Nevertheless, the cautious celebrant knows that plans for providing more energy or more water at the expense of Grand Canyon are only periodically defeated; unlike the native fauna, they rarely go extinct. ☐

Explore Majestic Alaska

Cruise Tour Alaska
This extraordinary cruise originates within Alaska, so more days are spent in the spectacular Inside Passage. Aboard the new MAJESTIC ALASKA EXPLORER, you'll visit more ports and scenic areas than on any other ship during a full week's cruise

Fly-Drive Alaska
Experience much more when you cover the long distance from home by air, then use a car or motorhome to explore this Great North Country in depth, in your own way and at your own pace!

Fish Alaska
Come for the world's best fishing...enjoy outstanding sport fishing lodges, fly-out fishing and charter yachts ...all amid Alaska's spectacular scenery. Just the right tempo for a rewarding few days of rest and relaxation.

ALASKA EXPLORATION HOLIDAYS
1500 Metropolitan Park Bldg.
Dept. NH
Seattle, WA 98101

Please send me the following free color Brochures.

☐ CruiseTour Alaska
☐ Fly-Drive Alaska
☐ Fish Alaska NH-1

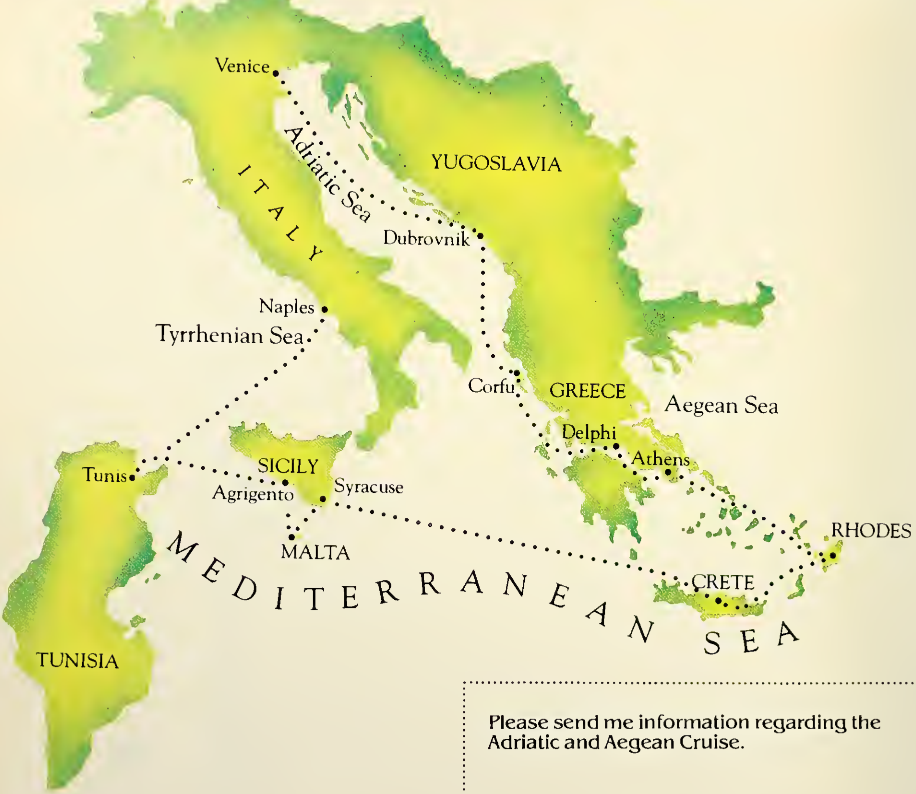
Name
Address
City
State Zip

A Division of Alaska Tour and Marketing Services, Inc

THE AMERICAN MUSEUM OF NATURAL HISTORY

Adriatic, Aegean & North Africa Cruise

August 31 to September 16, 1982


Venice
Adriatic Sea
ITALY
YUGOSLAVIA
Dubrovnik
Naples
Tyrrhenian Sea
Corfu
GREECE
Aegean Sea
Delphi
Athens
Tunis
SICILY
Agrigento
Syracuse
MALTA
RHODES
MEDITERRANEAN SEA
CRETE
TUNISIA

Discover the ancient and natural wonders of Italy, Greece, Crete, Sicily, Tunis and Malta with seven distinguished lecturers and friends of the American Museum.

Dr. Thomas D. Nicholson, Director of the Museum, invites you to join him on this unique educational vacation retracing the great historical travels of the Greeks, Romans, Phoenicians and Venetians.

Our custom-designed itinerary will be executed by Swan Hellenic whose meticulous arrangements assure you of a relaxed, care-free vacation.

Discuss the fascinating ancient sites with renowned experts in Classical times... see and identify a host of European birds in migration with our staff ornithologist... explore beautiful islands, sea coasts and volcanoes with our Museum geologist... share evenings on deck with Dr. Nicholson learning of the ancient navigators and the stars that guided them.

Please send me information regarding the Adriatic and Aegean Cruise.

Name (Please Print)

Address

City State Zip

American Museum of Natural History

Discovery Tours

American Museum of Natural History
Central Park West at 79th Street
New York, New York
Phone: (212) 873-1440

The Quasar Controversy Continues

Despite new observations and more theorizing, astronomers still disagree on the basics of these puzzling objects

by Stephen P. Maran

Some astronomers claim that photographs of quasars made with large telescopes show that these controversial objects tend to be found near bright galaxies. But the effect may not be real and is not accepted by most astronomers. Nonetheless, the photographs have led to a new theory that combines elements of earlier and conflicting theories concerning these quasi-stellar objects. According to the new theory, some of the quasars are really much fainter than they appear in the photographs, but their light has been focused, and thus made to seem brighter, by gravitational lenses on the outskirts of the galaxies.

For years, astronomers have argued about the proper interpretation of the telescopic photographs that show supposedly far distant quasars apparently grouped near bright galaxies that are much closer to Earth than the quasars. The photographs are mostly the work of Halton C. Arp, a noted observer of extragalactic phenomena at the Mount Wilson and Las Campanas Observatories in Pasadena, California. When spectra of both quasars and galaxies are obtained, Arp's quasars always have much larger red shifts than the galaxies. The majority of astronomers believe that the quasars are located well beyond the galaxies in the photographs and that the apparent proximity of quasars and galaxies is no more than a trick of perspective that results from the chance superimposition of foreground and background objects on the photographs.

The red shifts of galaxies are caused by two processes: the expansion of the universe and the Doppler effect. The expansion makes distant galaxies fly away from us, with the more distant galaxies traveling faster than the nearer ones. The Doppler effect shifts spectral lines toward the longer wavelengths (this is the "red shift") when the galaxy or other source of light moves away from the observer. The net result of these two processes is that the farther away the galaxy, the larger its red shift as measured from the earth. An approaching object, on the other hand, would have a blue shift (its spectral lines being shifted toward shorter wavelengths) due to the Doppler effect.

The minority view concerning Arp's observations holds that the quasar-galaxy groupings are so pronounced that they cannot be accidental. The adherents of this view insist that the groupings are true physical associations of quasars and bright galaxies and that the large red shifts of the quasars are therefore not indicative of their distances. If that is correct, then quasar red shifts (unlike those of galaxies) do not result from the expansion of the universe and quasars are much closer to us than the majority of astronomers believe. The majority view is summarized by the statement that quasar red shifts are "cosmological," that is, they result from the expansion of the universe, while the minority contend that the red shifts are "noncosmological."

The correct interpretation of quasar red shifts is a serious matter with implications for astrophysical theory. If the red shifts are cosmological, then quasars are typically much farther away than observed galaxies and (judging from their respective apparent brightnesses) they are much more luminous than the galaxies. Yet the physical dimensions of a quasar are very small, more like those of our solar system than those of the Milky Way galaxy. Thus, a consequence of the cosmological red shift interpretation is that quasars, all of which are very much smaller than galaxies composed of hundreds of billions of stars, somehow produce much more light than a galaxy. Explaining this fantastic rate of energy generation is a major problem in itself.

On the other hand, if the quasars in Arp's photographs really are grouped near the bright galaxies and are at the same distances from the earth as their respective adjacent galaxies, then the quasars are not very bright after all. They are just little specks alongside the galaxies. In this case, the question of quasar energy generation becomes a much less troublesome problem, but the cause of the quasars' noncosmological red shifts still remains a mystery. To a great extent, the quasar controversy is a debate between those astronomers who prefer to believe in objects whose red shifts can be explained even if their energy generation mechanisms are not understood and those who are willing to accept that the red shifts of quasars arise from an unknown cause, while taking satisfaction in avoiding the problem of perhaps inexplicably large quasar energies.

A few years ago, it seemed that the red shift controversy was settled when a University of Hawaii astronomer, Alan N. Stockton, obtained strong evidence that the red shifts of certain quasars that he had studied are indeed cosmological. The story was told here in "Quasars Confirmed" (*Natural History,* February 1980). And more recently, other evidence favoring the cosmological red shift interpretation has been collected.

For example, an international team of quasar researchers has discovered that the quasar 3C273 is located in a galaxy that has the same red shift as that quasar. Since galaxy red shifts are cosmological, the red shift of 3C273 must also be cosmological.

Despite these findings and others, those holding the minority view have not given up the fight. They maintain that even if the red shifts of certain quasars are cosmological, *other* quasars (such as those photographed by Arp) have noncosmological red shifts. The leading advocate of this position is Geoffrey R. Burbidge, director of the Kitt Peak National Observatory in Tucson, Arizona. On occasion, Burbidge has compared the majority's resistance to the idea of noncosmological red shifts with the overwhelming rejection of the theory of continental drift by geologists when that theory was first proposed.

The idea that some quasars have noncosmological red shifts even though Stockton's quasars have cosmological red shifts is not as illogical as might at first appear. After all, in our Milky Way galaxy, some stars have alternating red shifts and blue shifts due to their orbital motions in binary systems, while other stars have similarly alternating red shifts and blue shifts due to pulsating motions as the stars periodically swell up, contract, and swell again. Why shouldn't quasars likewise have red shifts due to two or more different physical causes?

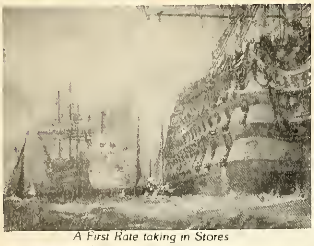
Two noncosmological explanations for quasar red shifts were proposed long ago in what are known as the gravitational red shift theory and the local theory of quasars. According to the gravitational red shift theory, the red shifts of quasars are due to powerful gravitational forces present in the quasars. This implies that quasars are very dense, compact objects. Analysis of the spectral lines, however, showed that they are emitted by atoms in a very extensive and thin gas, so the gravitational theory was rejected shortly after it was proposed. According to the local theory, quasars are objects hurled out of the Milky Way or a neighboring galaxy, and their red shifts are due to the high speeds resulting from whatever cosmic explosion originally launched them on their way. But in that case, we would expect that some quasars would also have been thrown out from other, more distant galaxies, and some of *those* quasars should be coming toward us. According to the Doppler effect, the putative approaching quasars would, of course, have blue shifts. But among hundreds of studied quasars, not a single blue shift has been found. Hence the local theory of quasars was also rejected.

No cogent physical theory remains to explain how quasar red shifts might be noncosmological. This does not mean that no such explanation is possible, but only that one has not yet been found. In any case, there remains the question of whether the quasar-galaxy groupings photographed by Arp are accidental manifestations of perspective, as most astronomers believe. The dissenting astronomers provide statistical calculations that purportedly show that these groupings cannot be accidental. Yet, spear carriers for the majority have made similar calculations with the opposite result. Much hinges on the assumptions on which each set of calculations is based. I have been unable to make an informed judgment on these conflicting computations. It appears to me that many quasar red shifts are clearly cosmological, however, while none have been proved to be noncosmological. Under the circumstances, the majority of astronomers have not broken ranks, but the dissidents still maintain their own views on Arp's observations.

Thus, it was with much interest that I recently read a new theory, proposed by Claude R. Canizares, a physicist and X-ray astronomer with the Center for Space Research at the Massachusetts Institute of Technology in Cambridge, Massachusetts. Canizares's theory, in brief, states that the brightness of a distant quasar is enhanced when the quasar happens to lie directly beyond a gravitational lens associated with a foreground galaxy and that the enhancements of brightness due to this effect cause some of these quasars to be observed when they would otherwise be too faint to be photographed. Thus, according to the theory, Arp may photograph more quasars around a foreground galaxy than are found in an equal area of sky that contains no such galaxy because the galaxy itself (through its associated lenses) makes background quasars look brighter.

A gravitational lens is simply a massive object, such as a black hole, star, or galaxy, that bends and focuses the light rays from a distant object. The first two proved cases of gravitational lenses that bend the light rays from quasars were reported in 1979 and 1980 (see "Seeing Double and Seeing Triple," *Natural History,* July 1981). In those cases, the lenses were entire foreground galaxies, whereas in the Canizares theory, the

UNIQUE TURNER OFFER



A First Rate taking in Stores
Signed "J M W Turner 1818" (19 x 17 in.)

Superb quality print of a very beautiful Turner watercolour Art historian B.L. Binyon wrote in 1909 "This is Turner at the peak of his powers, his palette is positively translucent" The original is in a private collection in England, and has rarely been seen since 1819, when it was exhibited at Grosvenor Palace

A few hundred copies were printed to commemorate Turner's bicentenary We have every one of them. There will be no more available once these few are gone

Print $14.90 (Framed $57.59)
Calif. residents add 6% tax. Tel. (213) 452-2443

OXFORD GALLERIES
2210 Wilshire Blvd. #627
Santa Monica, CA 90403

Name__________
Address__________
City__________ State_____ Zip_____
☐ VISA ☐ M C. #__________ Exp._____

The Wilderness Travel
World of Discovery

Wildlife & Natural History Tours
Anthropology & Archaeology Tours
Trekking Expeditions
Jungle Exploration

• CHINA •
• Kenya • Tanzania • Galapagos •
• Peru • Ecuador • The Amazon •
• Nepal • Australia •
• Alaska • New Guinea •

Write for our NEW 32-page fully illustrated 1982 catalog

Name__________
Address__________
Zip_____

WILDERNESS TRAVEL
1760-N Solano Avenue, Berkeley, California 94707
(415) 524-5111

INDIA
&
AROUND THE WORLD
with
Nepal-Sri Lanka-Bhutan
Burma-Thailand

Journeyworld offers you the architectural splendors and unforgettable sights of some of the world's most creative civilisations. You will see the Taj Mahal, Kathmandu in the Himalayas, the stupendous rock carved temples of Ajanta & Ellora, Bhutan a fairy tale Buddhist kingdom, colorful Kandy in Sri Lanka, the glory of Pagan and Mandalay the elephant camps and tribal villages of Chieng Mai.
The programs include comprehensive sightseeing, deluxe hotels and all meals.

For information call or write:

JOURNEYWORLD
155 East 55th St., New York, N.Y. 10022
Tel: (212) 752-8308

SPECTACULAR!

1982
THE ORIGINAL from CELESTIAL PRODUCTS

THE 1982 LUNAR PHASE POSTER/CALENDAR

The elegance of the moon's natural cycle displayed in a giant splash of color. Each day's astronomically corract phase is keyed to the date and day of the week. Detailed silver crescents provida fascinating patterns on tha dark blue "sky."

Your 16" × 37" graphic comes rolled in an attractive Gift Tube—just add a bow! We guarantae that your friends will want ona

PROMPT FIRST CLASS SHIPMENT $5.75 ppd aach, 2 or more—$5.00 ppd each. Discount gift list order torm and information on request. Check, VISA, MASTERCARD. Send Name, Address, Account #, Exp. date to:

CELESTIAL PRODUCTS, INC.
Dept. NH, 10 W Washington Street
Middleburg, Virginia 22117-0801

Countryside Walks
ENGLAND - SCOTLAND
Through quaint villages and lovely scenery. Along mediaeval footpaths, prehistoric and Roman tracks . . . 17-, 18-, 9- and 10-day tours . . . Relaxed pace . . . Small parties . . . Country inns . . .

Please send me further information:
Name ______
Address ______

Country Walking Holidays
6195 Santa Clara Pl., Rohnert Park, CA 94928

lenses are individual stars located in the thin outer regions of galaxies. These regions, called galactic halos, seem to contain many fewer stars in a given volume (say 100 cubic light-years) than are found in the main body of a galaxy. The halos are therefore much fainter than the main bodies and their properties are only poorly known. Nevertheless, Canizares estimates that a significant enhancement in the number of observable background quasars will occur as a result of gravitational focusing.

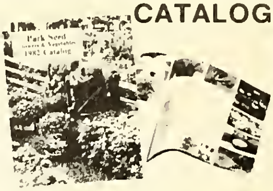
To test the Canizares theory, we will need improved information about the halos of galaxies, so that we can determine the number and nature of the stars present in the halos. Ideally, we should also find a specific case of quasar and foreground lens. The most likely indication would be the sudden fading of a quasar, when the lensing star moves off our line of sight. Quasars often brighten and fade or vice versa, but a sudden fading of several magnitudes with no subsequent pronounced brightening might be a telltale indication of a foreground lensing star moving off the line of sight.

We don't know yet whether Canizares's ideas are correct, and indeed I have heard little comment on them by the experts since they were published in June 1981 in the periodical *Nature*. Nevertheless, the Canizares theory is notable in explaining how each side in the divisive controversy may be partly correct. If Canizares is right, the majority of astronomers will have their cosmological red shifts, while the minority will be confirmed in their belief that there is something meaningful in the quasar-galaxy groupings.

The debate over quasar red shifts has lasted almost two decades. At times the protagonists have given each other's arguments less consideration than might seem warranted. It is hard to maintain objectivity when the results of years of research are challenged again and again. It would therefore be especially satisfying if Canizares were correct. The majority and the minority would then each be confirmed in a strongly held belief. The long controversy would be over, and neither side would be wholly the losers. The real gain, of course, would be in our knowledge of the universe.

Stephen P. Maran is a senior staff scientist in the Laboratory for Astronomy and Solar Physics at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

FREE
Big new PARK SEED CATALOG



OVER 3000 highest-yield vegetables and flowers—*"The Best of Both"*—all right here in Park's new FULL COLOR CATALOG. The choice NEW INTRODUCTIONS and the best proven all-time favorites. SEND FOR YOUR 124 PAGE CATALOG TODAY . . . It's yours FREE!

Geo. W. **PARK SEED** Co., Inc.
47 Cokesbury Rd., Greenwood, S. C. 29647
"Home Garden Seed Specialist Since 1868"

Please send to:
Name ______
Address ______
City ______
State ______ Zip ______
Geo. W. **PARK SEED** Co., Inc.
47 Cokesbury Rd., Greenwood, S. C. 29647

NEW!
FOR YOUR KITCHEN
Beauty and Versalility Combined.

The Butcher Block Kitchen Work Center is a convenient counter extender or an efficient work island...and the focal point of the kitchen you'll be proud of. Outstanding quality at a very reasonable price.

- Solid Rock Maple -- handcrafted in Vermont.
- Non-stick Butcher Block top 2'x3', standard counter height.
- Locking casters roll easily and stay put.
- 2'x3' lower storage shelf.
- Child-safe knife rack – many other features, too!

SPECIAL INTRODUCTORY PRICE!

Send today for FREE details!

Garden Way Research
Charlotte, VT 05445

©1981 GARDEN WAY INC

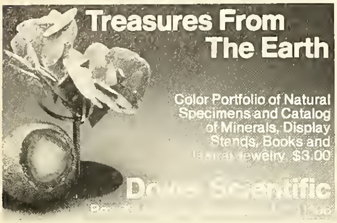
Butcher Block Kitchen Work Center
(Please Print Clearly)

Garden Way Research
Dept. A1604K
Charlotte, VT 05445

Name ______
Street ______
City ______
State ______ Zip ______

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: BOOKS-ON-FILE
Box 195 Dept. 72
UNION CITY, NEW JERSEY 07087



Treasures From The Earth
Color Portfolio of Natural Specimens and Catalog of Minerals, Display Stands, Books and [illegible] Jewelry, $3.00
D[illegible] Scientific

More Birds in Your Yard
or your money back!
Thistle Seed Feeder attracts finches, chickadees, nuthatches. Send $11.50 PPD.
Easy-to-install
Write for FREE Catalog today.
Free 2 lb. Thistle Seed with each feeder.
The Bird Tree
5336 East Bald Eagle Blvd., Dept. 84
White Bear Lake, MN 55110

In the spring and fall of 1982 we repeat our popular program for travelers who enjoy outdoor things:

Naturalist's Tour of the Scottish Highlands

MAY AND SEPTEMBER, 1982

We stay at small country inns and, by special permission, on the island of Rhum in the Inner Hebrides. We hike across moors, through forests and in unspoiled mountains among alpine flowers, sample local dishes and fine whisky, meet Highland people and listen to the sound of bagpipes.

Detailed brochures of this tour and a copy of our newsletter which lists all our fascinating travel programs, available from:

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

Sternberg and the Dinosaur Mummy

If you stop to think about it, human beings are not the only animals that will mummify under the right conditions. Given this observation, it is not surprising that the American Museum of Natural History, in addition to its large and famous collection of human mummies, also possesses the naturally mummified remains of various extinct animals. A glass case in the laboratory of the Vertebrate Paleontology Department houses the mummified skin of a baby woolly mammoth that lived in Alaska about 21,300 years ago. Tucked away in the Museum's storage areas are mummified odds and ends of other woolly mammoths and bisons, the mummies of a bison calf and moose dating from the late Pleistocene, and a box containing hair, skin, shreds of flesh, and marrow of an ancient musk ox.

Any organism whose tissues are exceptionally well preserved as a result of embalming or natural conditions (usually desiccation) can be called a mummy. The bison calf and moose mentioned above were probably freeze-dried—that is, the bodies froze and then over many years the ice in the tissues slowly sublimated. Other bodies mummify under extremely dry, desertlike conditions, in which moisture evaporates from the body before significant bacterial decomposition can set in.

The oldest and greatest mummy of them all is on display in the Hall of Late Dinosaurs. Lying on its back, with a gaping rib cage and grinning skull, is a fossilized trachodont, sometimes called a duck-billed dinosaur. The specimen looks like a partly decomposed carcass—one can amost smell it—but 65 million years of entombment have turned it completely to stone. Technically, therefore, it is not a real mummy, since none of the original body has been preserved, but is actually the fossil of what was once a dinosaur mummy. Not only did the dinosaur mummify under conditions of rapid desiccation and a complete absence of scavengers (a rare occurrence in itself) but once mummified it was quickly covered with sand and fossilized (also a rare occurrence). The result is an exceedingly unusual specimen of great value to science.

Skin, tendons, and shreds of flesh—all fossilized—cling to the trachodont's fossil bones. The animal's head is twisted behind its back in a grotesque arc, which paleontologists believe was caused by the drying and contracting of thick tendons in the neck. The trachodont mummy presents a sharp contrast to the carefully articulated, gleaming black skeletons of other dinosaurs in the hall, which give an impression of monumentality, stiffness, and formality. Not so much spectacular as it is gruesome, the trachodont reminds us that death was as unpleasant 65 million years ago as it is today.

The mummy was discovered in 1908 by Charles H. Sternberg, a free-lance fossil collector, and his three sons. Sternberg was an eccentric in the classic tradition of professional fossil collectors—an elite group that included Roy Chapman Andrews and Barnum Brown. He was a wizened man who walked with a stiff leg, was stone-deaf in one ear, quoted the Bible, and believed that God had personally called him to the life of a fossil collector.

It is worth taking a closer look at Sternberg. Science requires the activities of two very different kinds of people—the brilliant thinkers and synthesizers and the hardworking, unimaginative plodders. A great deal has been written about the former but virtually nothing about the latter. A member of the latter group, Sternberg is today almost forgotten despite his significant contribution to the advancement of vertebrate paleontology. He was never on the staff of an institution and never claimed to be more than just a fossil collector, although he did publish numerous papers and notes describing his finds. His scientific ideas tended toward the bizarre, and he was rarely given credit for his discoveries.

The son of a Lutheran minister, Sternberg was born in upstate New York in 1850 but grew up on a small farm outside of Ellsworth City, Kansas, where he learned to shoot buffalo and fight Indians. Ellsworth City was a rough place at the time. Every morning, the "dead cart" would pass through the center of town and pick up the bodies of those who had been killed in saloons and tossed into the street the night before. At age seventeen, Sternberg survived being shot in the head during a robbery. Nonetheless, it was in this environment that Sternberg had somehow found a copy of Darwin's *Origin of the Species*, a book that "thrilled" him and explained for the first time the presence of the many fossil seashells that, as a small boy, he had collected from an outcropping. As a teen-ager he vowed to devote his life to "collecting facts from the Crust of the Earth," a plan opposed by his father, who thought fossil collecting was a profession for those young gentlemen of wealth who needed a way to amuse themselves. Sternberg entered his chosen field in a businesslike manner, however, and financed his collecting by selling his finds to museums in the United States, Germany, England, and France. Although he never became rich (indeed, he occasionally suffered bitter poverty), he claimed that he made more money than if he had "utterly wasted" his life as a farmer or businessman. Part of his success was due to his luck—he would find rich fossil localities in areas that had already been thoroughly explored by others (he once wrote that he discovered these localities through dreams). Sternberg usually collected alone or, later in his career, with his three sons, who shared his enthusiasm for bones. One notable exception was the collecting he did with the brilliant and irascible paleontologist Edward Drinker Cope. Cope suffered from dreadful nightmares involving the dinosaurs he collected during the day, and his hideous screams kept Sternberg awake throughout the night.

Sternberg was a deeply religious man who wrote devotional poetry in his spare time. He also wrote and published an epic poem in quatrain, entitled "The Story of the Past: Or, The Romance of Science." In it, he writes about his feelings toward religion and science:

And I believe that God
  chose me,
Unworthy though I am,
To add my mite to Life's
  Great Tree,
To carry out His plan;

To Show man his wonderous work
Through all the scenes of time,
Since life in humble beings
  lurk:
Rich facts for us to mine.

Later in the same poem he describes unearthing a fossil mosasaur (and appropriately, switches his poetic form to heroic couplets in the style of Pope or Johnson):

A grinning skull first comes
  in sight,
Armed with strong teeth,
  all shining bright.
The spinal column follows fast,
On either side great paddles cast,

L.L.Bean
Spring 1982

L.L.Bean®

FREE Spring Catalog

Fully illustrated. Features quality apparel and footwear for men, women and children; hiking, camping and canoeing gear. For 70 years L. L. Bean has offered practical and functional merchandise at reasonable prices. Our clothing and footwear is rugged enough to withstand active outdoor use, yet attractively styled and comfortable for casual wear. Many items are of our own manufacture. All fully guaranteed.

☐ SEND FREE CATALOG

Name________________

Address________________

City________________

State________Zip________

L. L. Bean, Inc.
791 Casco St., Freeport, ME 04033

Now available with optional wooden floorboards!

The Quality Alternative to High-Cost Inflatable Boats!

Why pay $600. to $1000. or even more for an inflatable boat?

Sea Eagles pack small, last for years and cost $110. – $540.

Canoes, dinghies and motormount boats for fishing, river running, camping and yacht tending.

Sea Eagle 8, shown: • 9'7" x 4'6" • 31 lbs.
• Holds 4 adults • 3 hp capacity • Costs $220.

Write for our FREE brochure: Sea Eagle, Dept. NH1B, St. James, NY 11780

Or phone:
516-724-8900, 8:30 AM to 4:30 PM EST.

SEA EAGLE®

In 1974 we originated our epoch-making ***Galapagos Islands Thrift Cruises****, which for several years enabled many hundreds of budget-minded travelers who were interested in ecology, wildlife and photography to see these unique islands without luxurious trimmings but under expert guidance.*

We now again offer a budget program which includes some of the highlights which make a visit to this remarkable archipelago such a renowned tourist attraction. We explore five of the islands in order to view sea lions, iguanas and a large variety of birds, such as the famous Darwin's finches, boobies, frigates and gulls:

Galapagos Islands Thrift Program

APRIL 4 TO 14, 1982
JUNE 27 TO JULY 7, 1982
DECEMBER 26 TO JANUARY 5, 1983

Our program includes easy hikes on Santa Cruz to see tortoises roaming free and to the top of the dormant volcano at Sullivan Bay, and ample opportunities for swimming and snorkeling. It is ideal for young people and families with children and has been planned during periods of school and college vacations.

We do not claim that these programs are as comprehensive as our superb and unrivalled **Discover Galapagos** yacht cruises in August and October, 1982; but our meticulously supervised arrangements do provide you with a fascinating introduction to these wonderful islands—and at a third of the cost.

Each program is accompanied by one of our expert leaders and a naturalist guide who give informative talks and lead us in the field.

Before the week at the islands, we spend two days at the best hotel in Quito, Ecuador's lovely capital in the Andes.

Please send for the detailed brochure of these programs—we also specialize in expeditions to Greenland, Mount Kilimanjaro, the Himalayas and the Andes, wildlife safaris to see polar bears and seals in northern Canada and to Scotland, Borneo and Rajasthan; and archaeological tours to Peru, Morocco and Egypt.

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

WHEN YOU WRITE TO NATURAL HISTORY

about a subscription renewal, billing, or any kind of adjustment, please include your present address label.

Moving? Please notify 6 weeks in advance. Send your present address label along with your new address to Natural History Membership Services, Box 4300, Bergenfield, NJ 07621

Name ______________________
New Address ______________________
____
City ________ State ________ ZIP ________
Please Print Attach Label

> While a long tail of swimming form,
> Like a screw propeller it is born.
> The mended bones show us the place,
> Where he was injured in the chase. . . .

In 1908, Sternberg wrote the British Museum (Natural History) that he could find an excellent specimen of a triceratops skull in Converse County, Wyoming. The museum agreed to purchase a fine specimen if it were found, but would not commit itself to funding the expedition. There was reason to be skeptical, since the area had already been thoroughly searched by the American Museum of Natural History some years before.

Sternberg was accompanied on this expedition by his three young sons, who had never collected a dinosaur before. They were, naturally, very excited and spent weeks scouring the remote desert landscape without luck. When their food began to run out, Sternberg reluctantly saddled up his horse and cart for the five-day round-trip journey for more supplies. Just before he left, his son George found some bones sticking out of a sandstone outcropping. Sternberg and his eldest son went for supplies while the two younger boys, living on nothing but boiled potatoes, began chipping away at the surrounding sandstone matrix. George later wrote about the find:

> Finally by the evening of the third day, I had traced the skeleton to the breast bone, for it lay on its back with the ends of its ribs sticking up. There was nothing unusual about that. But when I removed a rather large piece of sandstone rock from over the breast I found, much to my surprise, a perfect cast of the skin impression beautifully preserved. . . . The head lay bent back under the body. Traces of the skin were to be seen everywhere. . . .

When his father returned to the camp five days later, George made the mistake of telling him about the dinosaur before dinner. Excited by the news, Sternberg insisted on visiting the site immediately. There would be no delay, not even for his starving son to eat some food. The two arrived at the site in the gathering dusk, and George recalled:

Leviathan

Roger Payne, a pioneer researcher of the habits and life histories of whales, will present *Whales: Their Behavior and Culture*, on Sunday, January 17, at noon and 3:00 P.M.. Using slides and tapes, he will discuss recent discoveries about these largest of living animals. During the past fifteen years, Payne has gone on forty-one global expeditions to photograph whales, record their singsong vocalizations, and study their "culture." This program is presented by the Membership Department in cooperation with the L.S.B. Leakey Foundation. Tickets are $6.50 for nonmembers and $3.50 for members and should be purchased in advance from Membership.

Dinizulu

The popular troupe *Dinizulu and His African Dancers, Drummers, and Singers* will perform in the Auditorium on Sunday, January 31, at 2:00 P.M. Free tickets will be distributed on a first-come, first-served basis on the day of the performance, starting at 11:00 A.M. near the first-floor information desk.

Lord of the Rings

The revealing photographs of Jupiter and Saturn, including their rings and moons, sent back by two Voyager missions are familiar to most Americans. Members of the Museum are invited to hear Tobias Owen, staff scientist with the NASA team that analyzed the photographs, in a free program on Wednesday, January 20, at 7:30 P.M. in the Auditorium. With color slides and film simulations, Owen will explain how the images were created and what they can tell us about these two giant planets in our solar system. This Membership Department program is open only to members; reservations are required.

New Natural History Films

The Education Department will show two nature films in the Auditorium on Saturday and Sunday, January 9 and 10. At 2:00 P.M., *Birds of the Indian Monsoon* looks at the great diversity of bird life on the plains of northern India through the four seasons. At 3:00 P.M., *The Sea Behind the Dunes* explores the animal and plant life of Cape Cod's saltwater bays and beaches. This program is free.

Museum Lecture Series

The popular afternoon and evening lecture series will begin this February. Among the subjects offered are archeology, natural history, anthropology, and zoology. Some highlights:

Lost Cities. Archeology has revealed the splendor and life of the lost cities of Mesopotamia, Assyria, and Persia. Excavations have exposed royal tombs with evidence of human sacrifices, clay tablets with the literature of vanished peoples, and streets and buildings of ancient cities. Some of the cities that will be ex-

One glance was enough for my father to realize what I had found and what it meant to science. Will I ever forget his first remark as we stood there in the fast approaching twilight? It thrills me now as I repeat it. "George, this is a finer fossil than I have ever found."

Sternberg also wrote about that moment:

> Shall I ever experience such joy as when I stood in the quarry for the first time, and beheld lying in state the most complete skeleton of an extinct animal I have ever seen, after forty years of experience as a collector! The crowning specimen of my life's work! . . . It lay there with expanded ribs as in life, wrapped in the impressions of the skin whose beautiful patterns of octagonal plates marked the fine sandstone above the bones. George had cut away the rock, leaving enough to give the impression that even the flesh was replaced by sandstone. . . . How wonderful are the works of an Almighty hand!

Henry Fairfield Osborn, president of the American Museum, had been keeping a close eye on Sternberg's activites. He heard about the find and, fearing the British Museum might get it, immediately dispatched a man to Converse County. The Museum's agent appealed to Sternberg's patriotic feelings with the promise that the specimen would remain on display in the United States, and secured it with an unknown amount of cash. The trachodont was encased in plaster, crated, and shipped to the Museum, where Osborn put it in a glass case with a label describing it simply as a "Mummy Dinosaur."

Sternberg collected other specimens for the Museum, but the trachodont was probably the finest. For the first time, paleontologists were able to study the skin texture and patterns of a dinosaur, the placement of some musculature, and other details not detectable from a skeleton. Whenever he was in New York, Sternberg would visit the Museum and roam about the dinosaur halls admiring his finds. On one such visit to the trachodont, he was inspired to write: "My own body will crumble in dust, my soul return to God who gave it, but the works of His hands, those animals of other days, will give joy and pleasure to generations yet unborn."

Douglas J. Preston

---

plored in this six-evening series are Ur in Sumer; Mari, where Zimri-lim built his palace; the biblical Nineveh with its fortress palaces and tablets from the royal archives; Babylon, city of astronomers and hanging gardens; and Persepolis, seat of the Persian kings. The series is taught by Claireve Grandjouan and costs $35.

Whales, Dolphins, and People. These six lectures focus on the endangered cetaceans and their relationship with human beings. Richard Ellis, who designed the Museum's great blue whale, will discuss such topics as the history of whaling; communication, language, and intelligence of cetaceans; life histories of the great whales; and the fate of the whales. The series costs $35.

Anthropology through Films. This series explores the cultures of the world through the immediacy of film. In a six-evening program, anthropologist Malcolm Arth will screen nine films, including films about Alaskan Eskimos, men in a Utah prison, Jewish immigrants in America, and Australian Aborigines. Arth will be joined by special guest filmmakers who will discuss their work. Tuition is $40.

Other Series. Thirteen other lecture series and field trips are being given this spring: *The World of Islam*; *Animal Life in Northeastern United States*; *Mushrooms, Mosses, Ferns, and Other Nonflowering Plants*; *Insects*; *Foraging for Dinner*; *Travel Photography*; *Visit with Museum Curators*; *Animal Drawing*; *Explore Weaving* (beginning and advanced); *Saturday Field Walks in Botany*; *Geology Nature Walks*; and *Weekend for Whale Watching.* Write or call the Education Department for a course-registration form.

Museum Expeditions

Now on display in the Center Gallery is *To the Ends of the Earth*, an exhibit of photographs from the Museum's four greatest expeditions: The Jesup Expedition to Siberia, Roy Chapman Andrews's eight-year trek in the Gobi Desert, the Congo Expedition, and Adm. Robert Peary's expedition to the North Pole. The photographs were selected from *To the Ends of the Earth*, by John Perkins, just published by Pantheon Books.

Courses for Stargazers

The American Museum-Hayden Planetarium is offering a number of courses in astronomy, celestial navigation, and meteorology this January. Write or call the Planetarium for a free course catalog and registration form.

For more information about programs listed in this section, call the appropriate department: Education Department (212) 873-7507; Membership Department 873-1327; Hayden Planetarium 873-1300, ext. 206. Or write to the department at the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024

Send me Burpee's® free 1982 seed catalog!

It's packed with over 400 vegetables and 650 flowers—including new varieties and Burpee exclusives! Plus fruits, shrubs, garden aids, and more! Send for yours *now!*

Clip and mail today!

W. Atlee Burpee Co.
16-72 Burpee Building in . . .
Warminster, PA 18974 or Clinton, IA 52732
or P.O. Box 748, Riverside, CA 92502.

Name ______________
(Please print)
Address ______________
City ______________
State ______ Zip ______
(If you ordered from Burpee in 1981, your new Catalog will be sent to you automatically.)

Free!

Edmund Scientific Catalog

4,000 Unique Items

Astronomy, Microscopy, Biofeedback, Weather, Alternate Energy, Binoculars, Optics, Magnets, Magnifiers, Tools, Unique Lighting, Lab Equipment, and much more. Over 4,000 unique and fascinating products. Send for our **FREE**, colorful 1982 Edmund Scientific Catalog . . . Today!

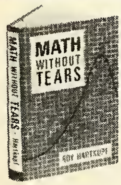
Rush me your free catalog!
Name ______________
Address ______________
City ______________
State ______ Zip ______

Clip And Mail Coupon Today To:
Edmund Scientific Co., Dept. 8211 E-02
Edscorp Bldg., Barrington, N.J. 08007
No. 3455 ©1982 Edmund Scientific Co.

EXPLORE
CANADA'S
ARCTIC

Bathurst Inlet Lodge is a small, exclusive naturalist's paradise 30 miles north of the Arctic Circle – the ultimate arctic experience!

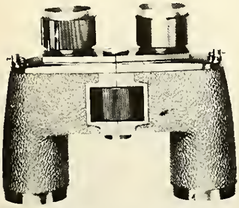
BATHURST INLET LODGE
P O Box 820
Yellowknife, Northwest Territories
CANADA XOE 1HO
Phone (403) 873-2595



MATH WITHOUT TEARS

Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written. *Learn math in the comfort of your own home at minimum cost.*

Order Now $10.95 plus $1.25 hdlg
EMERSON BOOKS, INC.
Dept 251G, Verplanck, NY
10596
10 Day Money Back Guarantee



BUSHNELL 7x35 CUSTOM
Mfg. List $280.00 Postpaid $164.00

This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

Each year, since 1972, we introduce at least one exciting new travel program; and for the summer of 1982 we offer our first tour into the most ruggedly beautiful, untamed region of Europe:

Adventure
in Montenegro
JULY 2 TO 17, 1982

Here, in the dramatic Dinaric Alps of Yugoslavia, our small and expertly led group will spend five nights under canvas and descend the Tara River by log rafts as it flows through pine forests and the huge Dumitor National Park.

Before the thrilling river journey we enjoy five days in historic Dubrovnik and the spectacular Dalmatian coast and visit Montenegro's ancient capital of Cetinje.

Detailed brochure available from:

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

Additional Reading

Brown Pelicans (p. 38)

"The Decline of Brown Pelicans on the Louisiana and Texas Gulf Coast," by K.A. King, E.L. Flickinger, and H. H. Hildebrand (*The Southwestern Naturalist*, vol. 21, pp. 417–31), traces the disappearance of brown pelicans from Louisiana and their great decline in Texas. This review examines the factors influencing pelican mortality, documents the pelican's population history and present status, and gives evidence for the involvement of DDE and other pesticides in the decline of the Gulf Coast brown pelican. "Brown Pelican Restocking Efforts in Louisiana," by S. A. Nesbitt et al. (*Wilson Bulletin*, vol. 90, pp. 443–45), reports on a restocking program that introduced birds from stable colonies in Florida into historic colony sites in Louisiana beginning in 1968; in 1975, however, an estimated 35 to 40 percent of the standing population of 400 to 450 pelicans was lost to endrin contamination. "Brown Pelicans: Improved Reproduction off the Southern California Coast," by D.W. Anderson et al. (*Science*, vol. 190, pp. 806–808), analyzes the significant rise since 1971 in productivity of California brown pelicans at their two northern colonies. The increase in adult breeding probably reflects food supplies and recruitment of breeding birds from more successful southern colonies; the steady rise in fledging success is attributed to better egg survival and improving eggshell conditions as a result of declining DDE contamination in anchovies, the pelicans' major food source. Other technical articles concerning the brown pelican include: "Seabirds in the Gulf of California: A Valuable, International Resource," by D.W. Anderson, J.E. Mendoza, and J.O. Keith (*Natural Resources Journal*, vol. 16, pp. 483–505), and "Brown Pelican: Population Status, Reproductive Success, and Organochlorine Residues in Louisiana, 1971–1976," by L. Blus et al. (*Bulletin of Environmental Contamination and Toxicology*, vol. 22, pp. 128–35). *Wonders of the Pelican World*, by J.J. Cook and R.S. Schreiber (New York: Dodd, Mead and Co., 1974), is a children's book, part of the Wonder Series, suitable for grades two to five.

Colorado River (p. 74)

A River No More, by Pulitzer Prize-winning journalist P. L. Fradkin (New York: Alfred A. Knopf, 1981), aims to "sketch the background, give a sense of place and people, define the issues, set forth the problems, and offer a few thoughts about the continued availability of Colorado River water and the viability of the West." According to Fradkin, the Colorado River, in its present state, is "primarily a product of the political process . . . rather than a natural phenomenon." Chapter five, "Canyon Country: The Ultimate Ditch" (pp. 181–284), discusses the effects of the Glen Canyon Dam on the Colorado and the political, environmental, and economic issues surrounding the river and its canyons. "Man's Impact on the Colorado River in the Grand Canyon," by R. Dolan, A. Howard, and A. Gallenson (*American Scientist*, vol. 62, pp. 392–401), also describes the environmental impact of the Glen Canyon Dam on the Colorado River and the Grand Canyon. *The Grand Colorado*, by T. H. Watkins and contributors, with color photographs by P. Hyde (Palo Alto: American West Publishing Co., 1969), profiles the river, emphasizing its 4,000 years of human history—from ancient times when Indians inhabited the Colorado canyons to the present day. Divided into three sections—"The Myth," "The Conquest," and "The Legacy"—the book also includes a chapter on the character and geologic history of the Grand Canyon district and a wide selection of rare maps, drawings, and photographs. J.W. Powell was the first person to travel down the full length of the Colorado River in 1868; his well-known, colorful account of his expedition, entitled *Canyons of the Colorado* when it first appeared in 1895, has been published many times under various titles. One of the paperback versions available is *Exploration of the Colorado River* (New York: Dover Press, 1961). *"Photographed All the Best Scenery,"* edited by D. D. Fowler (Salt Lake City: University of Utah Press, 1972), is J. Hillers's diary of the Powell expeditions 1871–75. A boatman who later became the chief photographer of the U.S. Geological Survey, Hillers was the first to photograph the Grand Canyon. His diary, presented in the first part of the book, adds new information about the second Powell expedition; the second part of the book reproduces his photographs. *Grand Canyon: An Anthology*, a compilation of articles by Arizona governor B. Babbitt (Flagstaff: Northland Press, 1978), examines the canyon from several viewpoints, including the historic, scientific, and aesthetic. This book is available in softcover for $8.95 from the publisher, P.O. Box N, Flagstaff, Arizona 86002. *The Grand Canyon: Early Impressions*, edited by P. Schullery (Boulder: Colorado Associated University Press, 1981), is an anthology of essays by sixteen authors, including J. Muir, D.S. Jordan, H. Garland, T. Roosevelt, and Z. Grey. D.J. Hughes's *In the House of Stone and Light* (Grand Canyon: Grand Canyon Natural History Association, 1978), a human history of the Grand Canyon, is available in softcover for $8.50 (including shipping) from Grand Canyon Natural History Association, P.O. Box 399, Grand Canyon, Arizona 86023. Other publications available from this association include *Introduction to Grand Canyon Geology*, by M. Collier (1980, 42 pages, $3.95), and *Grand Canyon Wildflowers*, by A.M. Phillips III, a field guide with 166 full-color plates (1979, 148 pages, $7.50 in softcover). *Corridors of Time*, by R. Redfern (New York: New York Times Book Co., 1980), is a photographic essay on the Grand Canyon, supplemented with text. Other noted books about the canyon are: J.W. Krutch's *Grand Canyon: Today and All Its Yesterdays* (New York: William Sloane Associates, 1969); *Grand Canyon of the Living Colorado*, edited by R. Nash (New York: Sierra Club and Ballantine Books, 1970); and *The Grand Canyon*, by R. Wallace with photographs by E. Haas (New York: Time-Life Books, 1972).

Rita Campon

AUSTRALIA.
CIVILIZED ADVENTURE.

Australia is unlike any other place on earth. You can walk back into time and leap into the future. All in the same day.

Join a rugged safari tour. Experience spectaculars like the vast Outback. The Great Barrier Reef. Living deserts and tropical rain forests.

Go game fishing, mountain climbing, camel-trekking. Ride around a sheep station. Pan for gold. Or hop off the trail and explore one of our cosmopolitan cities.

Send for our free Travel Planner. And take a tour of our continent before you come, mates.

See your Travel Agent or mail this coupon for your free Travel Planner.

Australian Tourist Commission
Distribution Center, P.O. Box A-1,
Dept. 151C-013, Addison, IL 60101

My special interest is ____

Name ____

Address ____

City ____ State ____ Zip ____

100% U.S. GOVERNMENT SECURITIES IN A NEW MONEY MARKET PORTFOLIO.

HIGH MONEY MARKET YIELDS
PLUS SAFETY PLUS FREE CHECK WRITING!

Now Vanguard offers you a choice of all-American money market portfolios.

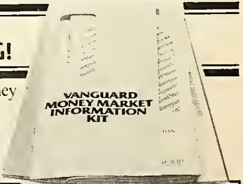
Their new Federal Portfolio consists 100% of securities guaranteed or backed by the U.S. Government and its agencies. So, although the Portfolio's shares themselves are not guaranteed or backed by the U.S. Government, all its investments are.

And Vanguard's popular Prime Portfolio invests primarily in high-quality money market securities of major U.S. banks and corporations.

Which Portfolio is right for you? Send for your free Information Kit, and then decide. You'll find full details of Vanguard Money Market Trust, including free check writing, no sales charge and low operating costs.

FREE MONEY MARKET KIT INCLUDES:

Informative Prospectus with full details and an Account Registration Form... "When you want more from your cash," an explanation of how the Trust works... and How to Write a Check and earn daily dividends until it clears.



FREE MONEY MARKET KIT:
CALL TOLL-FREE 800-523-7025*
OR MAIL THIS TODAY

Vanguard MMT, Drummer's Lane, Valley Forge, PA 19482

YES, please send me your exclusive Information Kit—including a prospectus, so I may read it carefully before I invest or send money. I understand that it includes more complete information about advisory fees, distribution charges and other expenses. 35-NH-B2-002

NAME ____

ADDRESS ____

CITY ____

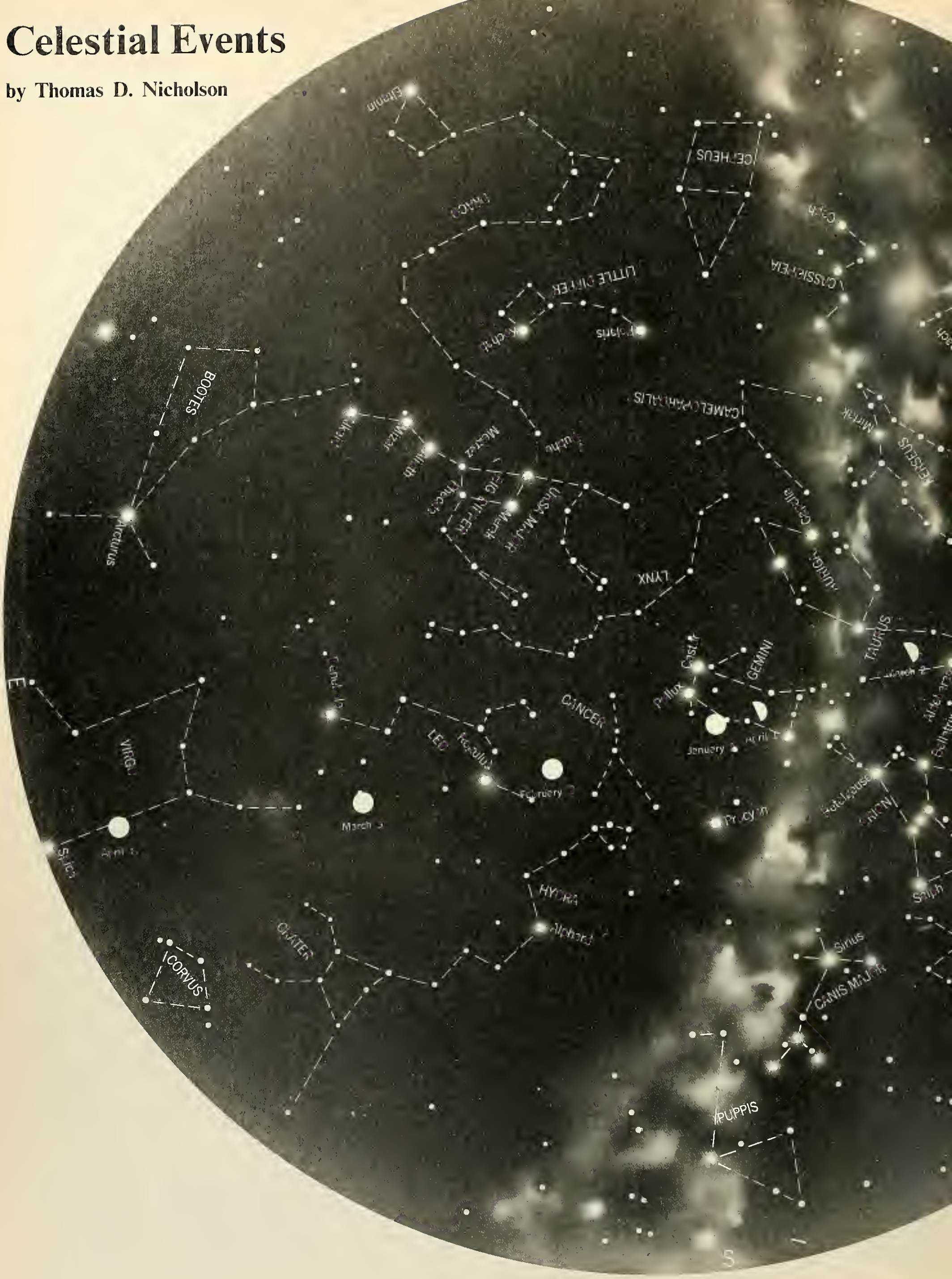
STATE ____ ZIP ____

*IN PENNSYLVANIA CALL 800-362-0530

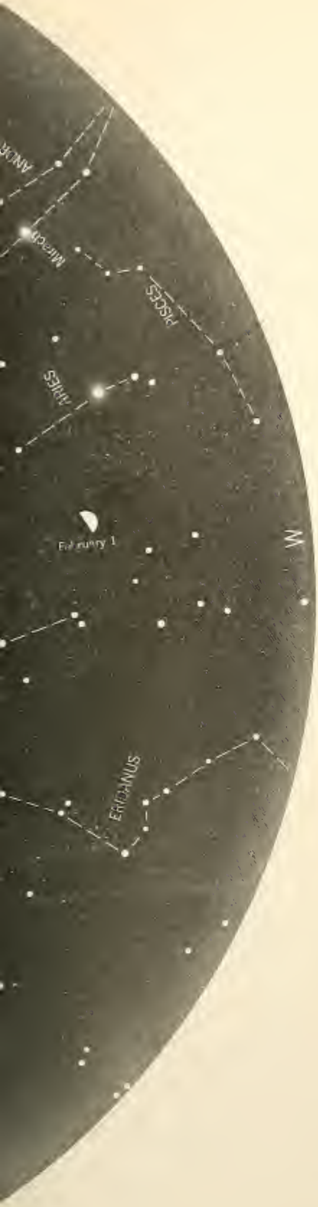
A MEMBER OF THE
Vanguard
GROUP OF INVESTMENT COMPANIES
OVER 50 YEARS OF SERVICE TO INVESTORS • OVER $3.5 BILLION IN ASSETS

Celestial Events

by Thomas D. Nicholson


Eltanin
DRACO
CEPHEUS
CASSIOPEIA
LITTLE DIPPER
Kochab
Polaris
CAMELOPARDALIS
Mirfak
PERSEUS
BOOTES
Arcturus
Alkaid
Mizar
Alioth
Megrez
Dubhe
BIG DIPPER
Phecda
Merak
URSA MAJOR
LYNX
Capella
AURIGA
TAURUS
Castor
Pollux
GEMINI
January
April 1
CANCER
LEO
Regulus
February 2
Denebola
VIRGO
March 3
April 1
Spica
E
Procyon
Betelgeuse
ORION
HYDRA
Alphard
CRATER
CORVUS
Sirius
CANIS MAJOR
PUPPIS
S

Helmut Wimmer



The Moon January is a good time to anticipate the coming of spring, a welcome three months away—a heart-warming thought. Look for the crescent moon on the night of January 1, and you will be looking very nearly at the vernal equinox, where the sun will be when spring commences. First-quarter moon is on January 2, and the waxing gibbous moon passes above Aldebaran (in Taurus) on January 6. Full moon on January 9 is in Gemini, and the two stars above it are Pollux (the brighter) and Castor. From the 15th through the 17th, the waning moon passes below the three bright morning planets (Mars, Saturn, and Jupiter), going through last-quarter on the 16th. New moon is on January 25, and the crescent of the next cycle will be visible on the last few evenings of the month. The moon is at perigee (nearest the earth) on January 8 and February 5; at apogee (farthest from the earth) on January 20 and February 17.

Stars and Planets The winter started out as a poor viewing time for evening planets, and it is getting worse. Venus, however poorly placed it was, could be seen in December, and maybe during the first week in January, but not after that. When it shifts into the morning sky on January 21, it leaves Mercury alone in the evening sky, and badly placed. For the last ten days of January, all seven of the other planets are morning stars. Three of them, Mars, Saturn, and Jupiter, are exceptionally well placed in Virgo, however, near its brightest star Spica. You will see them every clear morning from shortly after midnight until dawn. Mars rises first, before midnight, then Saturn and Spica close to one another (Saturn above), and lastly Jupiter, about an hour or so after midnight. By 3:00 A.M. or later, they will be well up in the east, stretched out in a line across the sky, drifting slowly westward. Jupiter, the trailing (lowest) planet, is brightest by far. Mars, the reddish-colored leader, and Saturn and Spica in the middle, are all about the same brightness early in the month, but by the end of January the quickly brightening Mars will easily outshine the other two.

January 4: Earth is at perihelion, the position in its orbit where it is nearest to the sun (about 147,102,000 kilometers, or 91,405,000 miles, distant). Perihelion, coming in the northern winter, and aphelion (where the earth is farthest from the sun), coming in the northern summer, moderate our seasons.

January 8: Saturn is in conjunction with Spica. The planet has been slowly approaching the star from the right and now moves to its left (east). But keep your eye on these two objects this year. Saturn is approaching opposition with the sun (April 18), and it will soon begin the retrograde (westerly) motion that always takes place for some months before and after opposition. This will take it to the right again to pass Spica in late February, and then to the left again (in June) to pass Spica in September. Another triple conjunction.

January 9: Mercury and Venus, both poorly placed evening stars, are in conjunction.

January 15–18: The waning moon passes by the gathering of planets in the morning sky (Mars, Saturn, and Jupiter, with the star Spica). Watch it daily (from 4:00 A.M. till dawn) to see its changes relative to the other objects.

January 21: Venus, not well placed as an evening star since last summer, is in inferior conjunction, passing between the earth and the sun from left to right. It now becomes a morning star.

January 22: Mercury is stationary among the stars and begins its retrograde (westerly) motion.

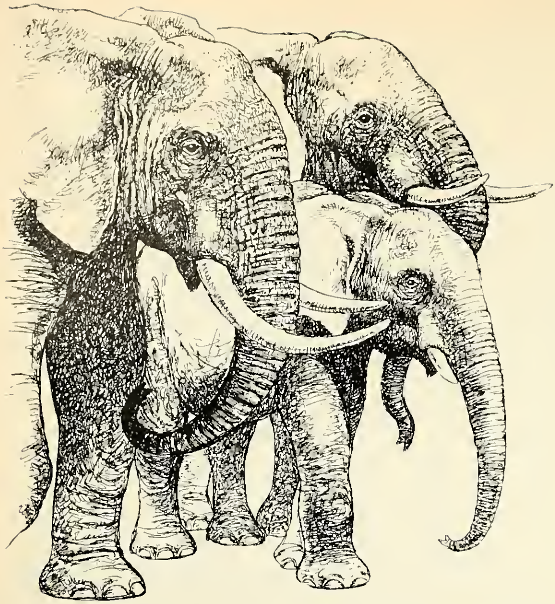
January 25: A partial solar eclipse occurs in the southern Pacific Ocean and Antarctica.

February 1: Mercury, in inferior conjunction, moves to the sun's right and becomes a morning star.

February 12–13: The waning gibbous moon moves from right to left past Mars, Spica, and Saturn, all close together in the morning sky.

The winter Sky Map shows the sky for the months of January, February, and March from latitude 40°N at the evening hours given below. To use the map, hold it vertically in front of you with the north (N) at the bottom, and match the lower half of the map with the stars you see when you face north. As you face in other directions, roll the map to bring the corresponding compass direction to the bottom of the map when facing you.

The stars move west continuously during the night. By morning (before dawn) stars on the western half of the map will have set, those on the eastern half will have moved into the west, and new stars (those of the spring evenings) will have risen in the east. The map represents the sky at about 2:00 A.M. on January 1; 1:00 A.M. on January 15; midnight on January 31; 11:00 P.M. on February 15; 10:00 P.M. on February 28; 9:00 P.M. on March 15; and 8:00 P.M. on March 31. Add one hour for daylight time. The map can be used for an hour or more before and after the times given.



THANK YOU FOR HELPING TO PRESERVE A NATURAL RESOURCE

The American Museum of Natural History warmly thanks those companies that have helped keep a door open to the natural world. Since its founding in 1869, the Museum has educated and entertained millions of visitors (over 2.5 million) per year and supported the scientists and vast collections that place us among the world's most important centers for natural history research. It is in large part through the generous contributions of our friends in the business community that we are able to continue this tradition of excellence. Those of you associated with companies that number among our Corporate Contributors should feel a part of this commitment and take pride in that fact. We gratefully acknowledge the following companies that have contributed $500 or more:

ACF Foundation, Inc.
AIRCO, Inc.
ALCOA Foundation
Allied Corporation Foundation
Allied Stores Foundation
AMAX Foundation, Inc.
Amcon Group, Inc.
Amerace Corp.
Amerada Hess Corp.
American Bank Note Company
American Broadcasting Company
American Can Company Foundation
American Electric Power Service Corp.
American Express Foundation
American Re-Insurance Company
American Standard Foundation, Inc.
American Telephone & Telegraph Company
Ametek, Inc.
AMF Foundation
Amstar Corp.
The Anaconda Company
Arthur Andersen & Company
ARCO Oil & Gas Company
ASARCO, Inc.
Ashland Oil, Inc.
Associated Dry Goods
Atlantic Bank of New York
Atlantic Richfield Foundation
Avco Corp.
AVNET, Inc.
Avon Products Foundation, Inc.
The Bank of New York
Bankers Trust Company
Barclays Bank International Ltd. Charitable Trust
Becker Warburg Paribas Foundation
Beneficial Foundation, Inc.
Bergdorf Goodman Company
Eleanor L. Bissinger
Block Drug Corp.
Bloomingdale's
Booz, Allen & Hamilton, Inc.
The Bowery Savings Bank
Bowne & Company, Inc.
Bristol-Myers Company Foundation
Bunge Corp.
Burlington Industries, Inc.
Capital Cities Foundation, Inc.
Guy Carpenter & Company, Inc.
Carter-Wallace, Inc.
CBS, Inc.
Celanese Corp.
The Chase Manhattan Bank, N.A.
Chemical Bank
Chesebrough-Pond's, Inc.
Chevron U.S.A., Inc.
Chicago Pnuematic Tool Company
Chiquita Brands, Inc.

Chubb & Son, Inc.
CIBA-GEIGY Corp.
Citibank, N.A.
Coach Leatherware
The Coca-Cola Bottling Company of New York, Inc.
The Coca Cola Company
Colgate-Palmolive Company
Community Ocean Services, Inc.
Consolidated Edison Company of New York, Inc.
Constans-Culver Foundation, Inc.
Continental Bank International
The Continental Corporation Foundation
The Continental Group Foundation, Inc.
CONOCO, Inc.
Coopers & Lybrand
Corning Glass Works Foundation
The Cowles Charitable Trust
Crum and Forster Insurance Company
Louise B. and Edgar Cullman Foundation
D'Agostino Supermarkets
The Daily News Foundation
Dancer Fitzgerald Sample, Inc.
Dean Witter Reynolds, Inc.
Deloitte Haskins & Sells
Dextra Baldwin McGonagle Foundation, Inc.
Diamond International Corp.
The Dime Savings Bank of New York
Discount Corp. of New York
Doyle Dane Bernbach, Inc.
Dun & Bradstreet, Inc.
Duval Corp.
East River Savings Bank
Emigrant Savings Bank
Charles Englehard Foundation
Englehard Minerals and Chemicals Corp.
Equitable Life Assurance Society of the United States
Esquire, Inc.
Ethan Allen, Inc.
Ethyl Corp.
The T. M. Evans Foundation, Inc.
Exxon Corporation
The First Boston Foundation Trust
Fluor Corp.
Flying Tiger Line
Ford Motor Company Fund
Franklin Savings Bank
F. William Free & Company
Freeport Minerals Company
Fribourg Foundation, Inc.
GAF Corp.
General Foods Corp.
General Reinsurance Corp.
General Signal Corp.
General Telephone & Electronics Corp.
Getty Oil Corp.
Gilman Foundation
Glamour Magazine
Goldfarb and Fleece
Grace Foundation
Graham & Sons, Inc.
The Greater New York Savings Bank
Greenwich Savings Bank
The Guardian Life Insurance Company of America
Gulf + Western Foundation
Frank B. Hall & Company, Inc.
Handy & Harman Foundation
Harcourt Brace Jovanovich, Inc.
Harlem Savings Bank
The Hearst Foundation
Heeramaneck Galleries
H. J. Heinz II Charitable and Family Trust
Home Life Insurance Company
Homestake Mining Company
International Business Machines Corp.
The IFF Foundation, Inc.
INCO United States, Inc.
International Paper Company Foundation
International Telephone and Telegraph Corp.
Irving One Wall Street Foundation
Jaros, Baum & Bolles
Johnson & Higgins
The Johnson's Wax Fund, Inc.
Joyce Beverages/New York
Kennecott Corp.
Kidder Peabody & Company
Kimberly-Clark Foundation
F. M. Kirby Foundation
Kliklok Corp.
Lebenthal and Company, Inc.
Lehman Brothers Kuhn Loeb Foundation
Leonhardt Foundation, Inc.
Lever Brothers Company Foundation, Inc.
The Lionel Corp.
Thomas J. Lipton Foundation, Inc.
Lord and Taylor
Leon Lowenstein Foundation, Inc.
R. H. Macy and Company, Inc.
Main Hurdman Foundation
Manufacturers Hanover Foundation
Marine Midland Bank
Marsh and McLennan Companies, Inc.
McCann-Erickson, Inc.
McGraw-Hill, Inc.
McKinsey & Company, Inc.
Melville Corp.
Mercedes-Benz of N.A.
Merck & Company, Inc.
Merrill Lynch & Company, Inc.
Metropolitan Life Foundation
Miles Metal
Mitsubishi International Corp.
Mitsui and Company
Mobil Foundation, Inc.
MONY Trust
Moore McCormack Resources Inc.
Morgan Guaranty Trust Company of New York
Morgan Stanley and Company, Inc.
William T. Morris Foundation
National Bank of North America
National Broadcasting Company Inc.
National Distillers & Chemical Corporation
NCR Corp.
New York Life Foundation
New York Telephone Company
The New York Times Company Foundation, Inc.
Newmont Mining Corporation
Newsweek, Inc.
The NL Industries Foundation, Inc.
Noranda Mines Ltd.
North American Philips Corp.
North American Reinsurance Corp.
Occidental Exploration and Production Co.
O.C.F. Foundation
Ogilvy & Mather, Inc.
Olin Corporation Charitable Trust
Oppenheimer and Company, Inc.
Otis Elevator Company
Owens-Corning Fiberglas Corp.
Pacific Transducer Corp.
Paine, Webber, Jackson & Curtis, Inc.
Peat, Marwick, Mitchell & Company
Pechiney Ugine Kuhlman Corp.
J. C. Penney Company, Inc.
The Pfizer Foundation, Inc.
Phelps Dodge Foundation
Philip Morris, Inc.
The Pren-Hall Foundation, Inc.
Price-Waterhouse & Company
The Procter & Gamble Fund
The Prudential Insurance Company of America
Robert K. Raisler Foundation, Inc.
RCA Corp.
Reading and Bates Offshore Drilling Co.
Reliance Group, Inc.
Republic National Bank of New York
Helena Rubinstein Foundation
Russell Reynolds Associates
Richardson-Vicks, Inc.
Rockefeller Center, Inc.
Rollins Burdick Hunter of New York, Inc.
Royal Insurance Company
The Rudin Foundation, Inc.
St. Joe Minerals Corp.
St. Regis Paper Company
Salomon Brothers Foundation, Inc.
Saudi International Bank
Schering-Plough Foundation, Inc.
Scherman Foundation, Inc.
Schlumberger Horizons, Inc.
Scientific American
Scovill Foundation, Inc.
Scudder, Stevens & Clark
Sears, Roebuck & Company
Shell Oil Company
Siemens Corp.
Simplicity Pattern Company, Inc.
The Smith Barney Foundation
Sony Corporation of America Foundation, Inc.
Sotheby Parke Bernet, Inc.
Speidel Newspapers Charitable Foundation
The Sperry & Hutchinson Company
Sperry Corp.
Sprague Electric Company
Squibb Corp.
Standard Brands Incorporated
The Starr Foundation
Sterling Drug, Inc.
Sugar Foods Corp.
Swig Weiler and Arnow Management Co., Inc.
Swiss American Securities, Inc.
Swiss Bank Corporation
Teachers Insurance & Annuity Association of America
Tenneco Chemicals, Inc.
Texaco, Inc.
Texasgulf, Inc.
Thomas & Betts Charitable Trust
J. Walter Thompson Fund, Inc.
The Oakleigh L. Thorne Foundation
Ticor Foundation
Tiffany and Company
Time, Inc.
Touche Ross & Company
Transway International Foundation
The Travelers Insurance Company
Tudor Foundation, Inc.
Unilever United States, Inc.
Union Carbide Corp.
Union Pacific Foundation
United Airlines Foundation
United Brands Foundation
United Industrial Corp.
U.S. Industries, Inc.
United States Life Corp.
United States Steel Foundation
United States Trust Company
Universal Leaf Tobacco Company, Inc.
Uris Brothers Foundation
Wallace-Murray Foundation
Warner Communications, Inc.
The Raymond John Wean Foundation
Pierre J. Wertheimer Foundation
Western Electric Fund
Westvaco Foundation
The Wheelabrator Foundation, Inc.
The Widder Foundation, Inc.
Lawrence A. Wien Foundation
John Wiley and Sons, Inc.
The H. W. Wilson Foundation, Inc.
Harry Winston, Inc.
Wyssmont Company, Inc.
Arthur Young & Company
Young and Rubicam Inc.
Carl Zeiss, Inc.

Contributors through October 26, 1981

THE MARKET

Art

IROQUOIS GAJESA Mid-Winter Festival Mask $43, request photo, McCoy Imports, Cold Spring Road, Liberty, NY 12754

PRE-COLUMBIAN COLLECTIBLES

GODDESS OF THE NEW MOON: AT'ACTANI —one of many splendid Mayan rubbings/serigraphs! Full-color catalog $2.00 (refundable first purchase).

BERNARDO
2400 Westheimer Road
Suite 108 West (NH1)
Houston, Texas 77098

ORIGINAL BOTANICAL AND NATURAL HISTORY prints by Redouté, Besler, Maria Sibylla Merian, and many others. Send $2 for new, illustrated catalogue to: Florilegium, Box 157 B, Palisades, NY 10964

SHOP AT HOME for fine art: Northwest Coast Indian masks, totems, graphics, Eskimo sculpture. Southwest Indian pottery, baskets, rugs, kachinas. No catalogue. One-of-a-kind pieces, individually photographed. Priced $100/up. Photos and data available. Specify interests. Box 5896, Sherman Oaks, CA. 91413. (213) 789-2559.

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHM, 84 Fifth Avenue, New York, NY 10011.

Books

BOOKFINDING. Librarians search worldwide titles or subjects plus 150,000 indexed stock. PAB, 2918 Atlantic, Atlantic City, NJ 08401 (609) 344-1943

EARTH AND MAN unique in the universe? "Improbable Planet" discusses the evidence. $8.95 to William Vincent, Rio Verde, AZ 85255.

GOING PLACES? Let the pocket-sized *Traveller's Aide* take the inconvenience out of packing. Contains useful basic organizing lists for 15 trips, plus many pages of travel tips. A great little Bon Voyage gift, too. Send $2.49 to Thunder Bay Enterprises, Box 25, Winooski, Vermont 05404.

NEW BOOKS REVIEWED. Know what's available before you buy. Latest natural history books, especially wildlife, thoroughly reviewed by scientists in "Fauna." Current issue $3. Fauna Society, Box 895, Rancho Mirage, CA 92270.

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalogue: Hamilton's, 98-55 Clapboard, Danbury, CT 06810

YESTERDAY'S BOOKS LOCATED, no obligation. Out-of-State Book Service, Box 3253J, San Clemente, CA 92672 (714) 492-2976

Collectors' Items

RECEIVE VALUABLE MINERALS MONTHLY! Free Details. Write Today! Mineral of the Month Club, 13057-H28 California, Yucaipa, Ca. 92399.

Correspondence

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin, West Germany.

ORIENTAL WOMEN SEEK CORRESPONDENCE for cultural exchange, language practice, friendship. Asian Exchange, Honokaa, Hawaii 96727

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest handbook, $2.00 (guaranteed). Australian International Services, Box 19107-RM, Washington, DC 20036.

AUSTRALIA—NEW ZEALAND NEED YOU! Big pay! 50,000 Jobs! Free transportation. Latest listings $2.00. Austco, Box 772, Cypress, CA 90630

A-U-S-T-R-A-L-I-A . . . N-E-W Z-E-A-L-A-N-D want you!! Jobs!! - Paid Transportation!! - Most comprehensive directory available!! - $3 - Moneyback guarantee!! "Australia" 2208-C1 Wisconsin Ave, NW, Washington, DC 22007

FREE DETAILS—OVERSEAS JOBS! All occupations! 68 countries. Paid fare. Computerized reports. Jobworld, Box 681, Cypress, CA 90630

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RM, Washington, DC 20036

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . . Intermountain 4Y, 3506 Birch, Cheyenne, WY 82001

TEACH HERE—TEACH ABROAD: School, College openings: USA $5.95; Abroad $5.95. Placement sources: USA $4.95; Abroad $4.95. EISF, Box 662, Newton, Massachusetts 02162

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Kenya. Sampler: 4/$2.98. Free Brochure. Multinewspapers, Box DE-201, Dana Point, California 92629

REMEMBER SOUP WITHOUT THE CAN? Heartwarming, nourishing Vegetable-Beef, Chicken Noodle, family heirloom recipes. $2.00, long SASE to P.O. Box 5046, Kokomo, IN 46902.

Garden

HERB SEEDS
Complete Reference Guide/Seed Catalog

Discover "holistic/organic" gardening. Everything needed to grow and use, 200 varieties of **Insect Repellants, Medicinal Herbs, Teas, Spices, Native Wildflowers, Wildlife Habitat Seeds.** Yours for $1. ppd. (Refundable). Introductory offer: 4 large seed pkts; Camomille, Balm, Calendula, Peppermint plus Catalog $3. Satisfaction guaranteed

NATURALIST SEED CO. • P.O. BOX 435 – N1
YORKTOWN HEIGHTS, NY 10598

WILDFLOWERS, HERBS, FERNS. Rootstocks, bulbs, plants. Illustrated catalogue $1, refundable with order. New England Rootstock Association, Dept. N1, Box 76, Cambridge, NY 12816.

Gourmet Interests

BEER BREAD, great for snacking. Easy to make. Send $1.00 to: P.O. Box 0186, College Grove Station, San Diego, CA. 92115

MINNESOTA WILD RICE. $7.00 pound, five pound minimum. Floura Bros., Box 44C, Blackduck, MN 56630

OUTSTANDING OATMEAL BREAD! Absolutely delicious. Old family recipe. $1.00 SASE to M.A., P.O. Box 1547, Kailua, HI 96734

REMEMBER SOUP WITHOUT THE CAN? Heartwarming, nourishing Vegetable-Beef, Chicken Noodle, family heirloom recipes. $2.00, long SASE to P.O. Box 5046, Kokomo, IN. 46902.

SIMPLY DELICIOUS! German cheesecake—Turkish Bakhlava—Russian apple pie. Send $3.00 SASE to P.O. Box 174, Ashley, ND 58413.

Government Surplus

"GOVERNMENT SURPLUS DIRECTORY." Buy 500,000 items (including Jeeps) . . . low as 2¢ on dollar! Most complete information available—$2.00. Disposal, Box 19107-RM, Washington, DC 20036

JEEPS, CARS FROM $35.00! 700,000 Items! Government Surplus—Most Comprehensive Directory Available Tells How, Where To Buy—Your Area—$2—Moneyback Guarantee—"Surplus Information Services," Box 3070-DC1, Santa Barbara, California 93105

Merchandise/Gifts

"I LIKE IT WILD®. . ." Wilderness/wildlife posters, T-shirts, note cards. Send stamped envelope: Wilderness Dreams®, Box 4455-N, Shawnee Mission, KS 66204

Miscellaneous

MOVIE STAR PHOTOS $4 each. Send requests to: MSP, 6721 E. McDowell, #320A, Scottsdale, AZ 85257

Music

OCARINA—Handcrafted, attractive pendant. Modern version of ancient musical instrument. Conversation piece. Ingenious 4-hole fingering plays chromatic octave. Accurately tuned, flute-like tone. Non-musicians: Play familiar songs with easy tablature. Including instruction/songbooklet, giftbox $12.90 postpaid. Handverks, 143B, Sister Bay, WI 54234

RECORDS-TAPES! Discounts to 73%. All labels; no purchase obligations; newsletter; discount dividend certificates. 100% guarantees. Free details. Discount Music Club, 650 Main Street, P.O. Box 2000, Dept 25-0182, New Rochelle, NY 10801

Old Time Radio

OLD TIME RADIO PROGRAMS on cassette tapes. Free catalogue. Cassette Library Center, P.O. Box 5331H, Baltimore, MD 21209

Optical

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON. Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired. Large stock. Orders filled postpaid day received. Birding, Box 5N, Amsterdam, NY 12010

Photography

TRAVEL MOVIES. If you have movies of your travels we are interested in screening them for possible inclusion in a documentary film about tourism. Red Hill Films, 191 East 2nd St., New York, NY 10009. (212) 677-1401

Real Estate

FREE! Big Spring Catalog! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Recreation, Retirement buys! Selected best throughout the U.S. Over 700 offices 43 states all across America! Yours free from the world's largest! STROUT REALTY, Inc., 60 E. 42nd St., Dept. 5390, New York, NY 10165. Call toll free: 1-800-641-4266

GOVERNMENT LANDS . . . FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00. Lands, Box 19107-RM, Washington, DC 20036

NEW. FREE. Big Spring Catalog. Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Recreation, Retirement Buys! Selected best throughout the U.S. Over 700 offices, 43 states all across America! Yours free from the world's largest! STROUT REALTY, Inc. 60 E. 42nd St., Dept 5390, New York, NY 10165. Call toll free: 1-800-641-4266

Resorts

ALASKA. SADIE COVE WILDERNESS LODGE where the mountains meet the sea. Excellent fishing, birdwatching, photography, relaxing. Brochure. Keith Iverson, Box 2265A, Homer, Alaska 99603

NATURAL HISTORY MAGAZINE

NEW SUBSCRIPTIONS OR RENEWALS

SAVINGS CERTIFICATE

For *FOR THE SUM OF 9 DOLLARS*

This Subscription Savings Certificate represents a saving of $9.00 off the single-copy newsstand rate for a full year (12 issues) of NATURAL HISTORY magazine, and includes membership in the American Museum of Natural History as well.

☐ **YES!** Please send me a full year of NATURAL HISTORY for the low rate of $15 for twelve issues, and my membership card.

☐ I want to save more. Send me two years of membership and 24 issues (two years) of NATURAL HISTORY for only $26 (a $22 savings off the newsstand rate).

☐ I want to save even more. Send me three years of membership and 36 issues (three years) of NATURAL HISTORY for only $35 (a $37 savings off the newsstand rate).

☐ Payment enclosed ☐ Bill me later **Send gift to:** J531

Name ____ (please print) Name ____ (please print)

Address ____ Address ____

City ____ City ____

State ____ Zip ____ State ____ Zip ____

☐ New ☐ Renewal ☐ 1 year $15 ☐ 2 years $26 ☐ 3 years $35

Outside of U.S. and Canada, add $3 per year. Please allow approximately 7 weeks for delivery of first issue.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

POSTAGE WILL BE PAID BY ADDRESSEE

NATURAL HISTORY
P.O. Box 4200
Bergenfield, N.J. 07621

FAR OFF THE BEATEN TRACK . . . Very small, very special hotel tucked into a 30 acre plantation on the island of Bequia, St. Vincent Grenadines, W.I. 10 rooms, fresh water pool, beautiful beach, snorkeling, hiking, photography, birding, tennis. Write or call: Spring on Bequia, Box 19251, Minneapolis, MN 55419, (612) 823-1202, or your travel agent. Member of Distinguished Inns and Historic Hotels.

IDAHO WILDERNESS. Small family homestead on beautiful Selway River. No roads Access by horseback along historic Nez Perce Trail. Comfortable cabin accommodations, home-style meals, fishing, riding, hiking, rafting. Two weeks (minimum) - $750. Selway Lodge, Box 1100-H, Hamilton, MT 59840

NEW MEXICO. Guided tours—wildflowers, birds, prehistoric dwellings. Bear Mountain Ranch, Silver City, NM 88061 (505) 538-2538

OLD FASHIONED, Secluded Farm on Cape Breton Island offers log cabins, excellent meals, peace to a few guests. $250/week. Write: John Gardner, Orangedale, Nova Scotia

Rentals

ADIRONDACK LODGES on Upper Saranac Lake. Available for two weeks or a month, July through September. Everything provided for comfortable living in the quiet woods. $650-$1,700 for two weeks. Please write Bartlett Carry Club, RFD 3, Tupper Lake, NY 12986.

CARIBBEAN: Relax on quiet, unspoiled island. Modern 2 bedroom villa. Wm. Pearson, 1917 Five Mile Line Rd. Pentield,, NY 14526. (716) 586-1989.

CROSS-COUNTRY SKI LODGE. Remote, quiet, 10 guest maximum. Sauna, unusually good food. Gulf Hagas Gorge. Little Lyford, Brownville, ME 04414 (207) 695-2821

ST. JOHN, VIRGIN ISLANDS apartment for two. Vacation: swimming, snorkeling, exploring National Park. $325 weekly. Barsel, Box 114, St. John, U.S.V.I. 00830

Schools

FREE - PARENTS GUIDE. Over 400 private building schools, camps and summer programs in U.S. and abroad, serving children 6-16. Most visited by publisher. For guide and free referrals give child's age, grade, interests, geographical preference and entrance date. Established 1940. Vincent/Curtis, Rm. 216, 224 Clarendon St., Boston MA. 02116

Tours/Trips

ADVENTURES WITH WILDLIFE—Whale Watch cruises with gray whales, humpbacks, and even blue whales. African photo safaris viewing gorillas in Rwanda, wildlife and birds in Kenya, Tanzania, Zambia, Botswana, and Madagascar. New brochure with 24 trips. ADVENTURES INTERNATIONAL Dept. NC 4421 Albert, Oakland, CA 94619

ADVENTURE TRAVEL: Tanzania, Camping Safaris, Peru natural history, Himalayan Treks, Australian Adventures. Special birdwatching and natural history departures. Overseas Adventure Travel, 1430 Mass. Ave. #303N, Cambridge, MA 02138 (617) 876-0533

ALASKAN WILDERNESS FAMILY invites you to share their coastal wilderness. Sincere, informal hospitality in a spectacular sea and mountain panorama. The place for those desiring quiet solitude; for birders, naturalists, photographers. 30 foot tides, prolific seabird and marine life. Glaciers, nesting eagles, bears, sea otters, seals, whales, untracked beaches, forest trails. Pull in crab and shrimp pots; catch salmon, trout, halibut; dig clams, gather mussels. An in-depth, educational experience. 8 guests only. $1125.00/5 days. Cozy cabins, gourmet meals. Called America's best wilderness lodge. The McBrides, China Poot Bay via Box 956NH, Homer, AK 99603, radio/phone (907) 235-8910. Write for brochure.

ALASKAN WATER ADVENTURES. Kayaking, Rafting, Birding in Prince William Sound and Copper River Basin Open Door, Box 1185N, Cordova, Alaska 99574 (907) 424-7466

CANOE CANADA'S ARCTIC. Remote fly-in canoe expeditions in the heart of North America's last great wilderness—the tundra and taiga of Canada's Northwest Territories. Photograph caribou herds, white wolves, muskox, moose, grizzlies, rich birdlife. Spectacular fishing. Groups of 6 or 8 persons assembled and guided by Alex Hall, wildlife biologist and veteran arctic canoeing guide. All food and equipment provided Can accommodate a limited number with no previous canoeing experience. Twelve days from $1,051.00; eighteen days from $1,813 00. For brochure write: Canoe Arctic Inc., Box 130 (C), Fort Smith, NWT, Canada X0E 0P0.

CANOE TRIPS in wilderness Nova Scotia, July-September Small groups with licensed guides. Excellent food. Write: Granville Nickerson, RR4N, Annapolis Royal, NS B0S 1A0, Canada.

CHINA BICYCLE TOURS. Unique, leisurely excursions through Chinese countryside, ideal for wildlife observation. 19-23 days from $1275 inclusive plus airfare. China Passage, 302 Fifth Avenue, New York NY 10001. Toll free (800) 223-7196.

CROSS-COUNTRY SKI from hut to hut in the high Wallowa Mountains of northeastern Oregon. Or hike and learn in the River of No Return Wilderness of Idaho. Trips for all abilities, everything provided and small groups. Write: Wilderness Trails, P.O. Box 9252N, Moscow, Idaho 83843 (208) 882-1955

DISCOVER BAJA! Join professional naturalists & crew for ocean going exploration of Baja's wilderness islands and lagoons. Gray whales up close, elephant seals, superb birding & lots more! Excellent photo opportunities, small groups. Color brochure. Pacific Adventures Charter Service, 2445 Morena Blvd., Suite 200H, San Diego, CA 92110

ECONOMIC GALAPAGOS. Weekly departures. Seven or fourteen nights in Galapagos with optional Ecuador, Amazon, Peru University credit available; non-students welcome. Dr. R. Lainhart, Biology Dept., Towson State University, Towson, MD 21204 (301) 321-2443 or 922-3116

FASCINATING NATURE, LEGENDARY CULTURES: Uncommon Travel programs to Latin America (featuring Peru, Galapagos, Amazon), Africa (even Rwanda, Madagascar!), Europe. Groups/Freelance. Forum Travel, 2437 Durant, Berkeley, CA 94704. (415) 843-8294

FREIGHTER CRUISES—First Class—Exotic—$50 daily and less. TravLtips Freighter Association, 16309-B5 Depot Road, Flushing, NY 11358

GALAPAGOS HIKING AND SAILING EXPEDITIONS. Small groups. 1982 dates: February 4, April 22, July 7, August 4 Charters. Machu Picchu options and Chili ski options. Inca Floats, 5982N Balboa, Oakland, CA 94611 (415) 339-9095

HORSE-DRAWN ODYSSEY—Greece. Rural, Ancient, Modern. Two weeks, April. All ages. Grassroots Expeditions, Freedom, Maine 04941 (207) 342-5422

THE ISLANDS OF HAWAII—NATURALLY. July 11-29, 1982. Explore environment and ecology in Maui, Kauai, Hawaii, Oahu. See the Hawaii most tourists miss. College credit available. Field Studies in Natural History, Dept. A-1, San Jose University, San Jose, CA 95192.

LEARNING ADVENTURES. Van safaris of the Southwest, Box 214, Boulder City, NV 89005 (702) 293-5758

MAYA & INCA: "1982 Art, Architecture and Archeology" Field Trips, with Nicholas Hellmuth. Seldom visited Yucatecan/Peruvian sites. Other unusual programs. Forum Travel, 2437 Durant, Berkeley, CA 94704. (415) 843-8294

NATURE TOURS to all parts of the world. Free brochure listing 1982 tours to Texas, Arizona, Oregon, Washington, Costa Rica, Panama, Peru, Greece, Spain, Morocco, Iceland, Malaysia, China, India/Nepal. World Nature Tours, Box 693a, Silver Spring, MD 20901

OCEANOGRAPHIC EXPEDITION Divers, naturalists needed for reef research project in New Hebrides, Solomons, PNG, Coral Sea Share expenses, chores, sailing. Three 1982 segments begin: April, July, September. Box 1644, Brisbane, 4001, Australia

PERU/GREECE/TURKEY: 3 unusual trips. Textile Arts, Archeology, People. Expert leadership. Forum Travel, 2437 Durant, Berkeley, CA 94704. (415) 843-8294

PERU: MACHU PICCHU AND EXPLORER'S INN. Limited space available in Princeton University's Alumni College "Art & Nature in the Land of the Condor," June 1-16, 1982. Professor John Terborgh, Department of Biology, foremost authority on Peruvian birds; Gillett Griffin, Curator of Pre-Columbian Art, Princeton Art Museum. Small group. $3250 includes all expenses. Princeton University, Box 291, Princeton, NJ 08544 (609) 452-3350

RAFT & KAYAK IDAHO'S SALMON RIVER—exciting rapids & serene floating through majestic mountain landscapes. Brochure: SALMON RIVER OUTFITTERS, Box 307N, Columbia, CA 95310 (209) 532-2766

SERENGETI: MIGRATION OF WILDEBEEST. 1982 departures. Send for details. Overseas Adventure Travel, 1430 Mass. Ave. #303N, Cambridge, MA 02138 (617) 876-0533

SHAMANS & HEALERS OF ECUADOR. A unique journey through the mountains and jungles of Ecuador to study the healing ceremonies and magic rituals of four Indian tribes. Anthropologist led. July 6-28, 1982. Write: Wilderness Travel, 1760-CS Solano Ave., Berkeley, CA 94707

STUDY BACK-STRAP WEAVING this summer in Otavalo, Ecuador with the Tahuantinsuyo Weaving Workshops. Two week sessions July and August. Write: Wilderness Travel 1760-CW Solano Ave., Berkeley, CA 94707

TREK KASHMIR/LADAKH, INDIA. From the fabled Vale of Kashmir to high desert reaches of "Little Tibet." Contact experienced Himalayan trip leader, Lila Bishop, 6804 Millwood Road, Bethesda, Maryland 20718

Workshops

SAMPLE PREPARATION TECHNIQUES. New York Microscopical Society workshops start January 16, 1981. Write Ms. Margaret Cubberly, Columbia Medical Center, 630 West 168th St. New York, NY 10032. Registrar

RATES AND STYLE INFORMATION

$1.75 per word, 16 word ($28) minimum. *Display classified* is $150 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY to: The Market, NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024. Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—1st of the month, two months prior to cover date (the January issue closes Nov. 1). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

Box numbers, telephone numbers, and hyphenated words count as two words; abbreviations and zip codes as one word each. All states are shown in two-letter code followed by zip, then telephone (with area code), if desired. Occasionally, slight editing is required for clarity. Thank you!

Enter the world of Questers nature tours.

Stimulate your mind on a Questers tour

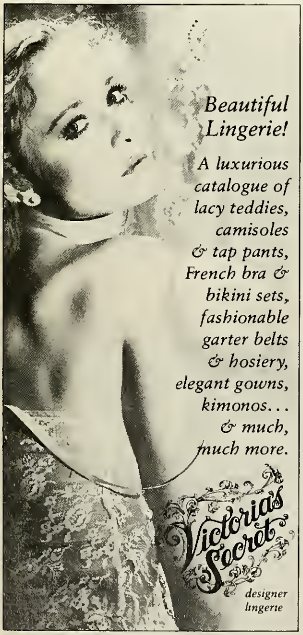
We search out the plants and animals, birds and flowers and explore the rain forests, mountains and tundra, seashores, lakes and swamps. Tours are under the leadership of a naturalist, and range from 9 to 35 days There is ample time to photograph, absorb, reflect Tour parties are small, accommodations are first class, and all meals are included

The current Directory of Worldwide Nature Tours describes tours to *In Africa*—Zimbabwe, Botswana, Kenya *In Asia*—India, Nepal, Bhutan, Sri Lanka *In Australasia*—New Zealand, Australia *In Europe*—Iceland, Greece, Spain, Switzerland, Scotland *In the Americas*—Everglades, Alaska, Baja California, Hawaii, Pacific Northwest, Costa Rica, Panama, Amazon, Patagonia, Galapagos

Write today for a free copy of the Directory of Worldwide Nature Tours.

QUESTERS

Questers Tours & Travel, Inc.
Dept. NH, 257 Park Avenue South
New York, NY 10010 • (212) 673-3120



Beautiful Lingerie!
A luxurious catalogue of lacy teddies, camisoles & tap pants, French bra & bikini sets, fashionable garter belts & hosiery, elegant gowns, kimonos... & much, much more.
Victoria's Secret
designer lingerie

Send $3 for catalogue to Dept.NH-01
Box 31442, San Francisco, CA 94131
Boutiques: San Francisco, Palo Alto & Cupertino, CA

Science in Installments

by Edward Edelson

Life on Earth. Produced by the BBC in association with Warner Brothers. To be shown nationally on the Public Broadcasting Service (PBS), beginning Tuesday, January 12, at 8:00 p.m., EST. Repeated Sundays at 7:00 p.m., EST (check newspapers for local time).

"Life on Earth," a thirteen-part series on the development of life on this planet, is an excellent example of both the strengths and weaknesses of television. It is the strengths that are most obvious at first, and they are so overwhelming that it takes some time for a viewer to entertain anything but admiration. Television's greatest asset is its ability to show something happening, and the photographers of "Life on Earth" have seized their opportunity with both hands. They have given us some impressive film images.

Money seems to have been spent freely and wisely. If the subject is the Grand Canyon, we are taken there; if a point is to be made in Newfoundland or Australia or Scotland, the cameras are on the spot. Every advanced technique of photography appears to have been used to capture a number of fascinating sequences: the coordinated beating of a dragonfly's wings; the mating ritual of scorpions; the family life of baboons; the Japanese macaques that have learned to wash sweet potatoes and rice in the sea. The list goes on. A well-tuned color television set is essential for full enjoyment of the series. To appreciate the advantage that television enjoys, compare the series with the book based on it, *Life on Earth,* by David Attenborough (Little, Brown and Co., $22.50). The book gives the text of the narration, with some inevitable minor adjustments and a large number of splendid full-color pictures. Good as they are, the still photographs cannot match the moving pictures of the same subjects. It is the difference between being in the Alps and having a picture postcard of them.

The narration by David Attenborough, a zoologist and anthropologist, is informative and literate (it is refreshing to hear the word *detritus* used casually on television). The structure of the series is simple and logical. It starts with the beginnings of life on earth and proceeds through time and increasing complexity, concluding with the human race. Attenborough has a neat turn of phrase and the ability to offer an illuminating comment about almost any scene we are viewing.

After that sort of praise, what is there left to criticize? Attenborough's treatment of evolution offers a point of entry. Its great merit is its no-nonsense acceptance of evolution. "Life on Earth" is a British production (with some Warner Brothers money), and the believers in a flat earth seem to be less powerful there than here, which of course made things simpler. Still, with the power of the yahoos growing it is good to hear the scientific facts presented without sops for the ignorant. But here is the quibble. Attenborough's evolution is the natural selection of Charles Darwin, straight and simple. There is no indication that scientists are arguing vigorously over a number of competing ideas of evolution, including random drift, punctuated evolution, and even Lamarckism, revived in molecular form. "Life on Earth" has no room for that sort of controversy because it has no room for science as a living, changing process full of ferment. The series' purpose is to present us with a series of tableaux, each vivid, each presented neatly in sequence, but each oddly isolated because it is all surface and no depth.

We get no idea of the effort that went into making the scientific discoveries that made the tableaux possible. There is an occasional "scientists discovered" or "this is what scientists saw," but the only scientist who actually is named is Charles Darwin. A decision was obviously made to subordinate everything

High yields?
Yes.
Easy access?
Yes.
Free checks?
Yes.
And no penalties!

Start with just $2,500. You can add to your account at any time with investments as low as $100. And you're not locked into any time period. Your money is always available whenever you need it, with no penalty for withdrawal. For full details on this popular money market fund, mail coupon or call today.

Dreyfus Liquid Assets

2260110

For more complete information, including management fee charges and expenses, obtain a prospectus by sending this coupon. Read it carefully before you invest or send money.

Name______________________________________
Address_____________________________________
City____
State_________________________Zip____________

0479

Post Office Box 600
Middlesex, NJ 08846

FOR A PROSPECTUS
Call toll free, day or night,
7 days a week
1-800-345-8501
Extension 295
In Pennsylvania
1-800-662-5180 Extension 295

Of course, in a bank your principal is insured and does not fluctuate, but your investment has a fixed return.

Sale! LAST TIME AT THIS PRICE!

Due to the soaring cost of GENUINE LEATHER, we cannot hold this price much longer. Order now!

The World's Most Comfortable Shoe!

Not $50 Not $25

Here Only $14.88

Genuine Leather

Smooth or Sueded

NOW! BLISSFUL COMFORT MORNING TO NIGHT! The closest thing to going barefoot! Handsomely-styled CosmoPedic shoes are the ultimate in comfort . . . and quality-crafted with features you'd expect to find in a **$50** or **$25** shoe! Luxurious genuine leather uppers in deer-tanned smooth or sueded leather are incredibly soft, yet amazingly shape-holding. The unique CosmoPedic arch support assures comfort thru long hours of standing or walking. A stitched collar prevents annoying chafing around the ankles. And for that walking-on-air feeling . . . comfort insoles and crepe soles pamper your feet from heel to toe! In Tan or Black smooth leather; Brown sueded leather . . . just **$14.88!**

TRY THEM AT OUR RISK! Return Within 14 Days for Money Back (except post. & hdlg.).

for Men and Women

Men's ½ sizes: 7 to 12, also 13
Width: C, D, E, EE, EEE
Women's ½ sizes: 5 to 10, also 11
Width: B, C, D, E, EE, EEE

THE DIPLOMAT SHOP
Hanover, PA 17331

SATISFACTION GUARANTEED OR MONEY BACK

THE DIPLOMAT SHOP, Dept. FM-3648, 340 Poplar Street, Hanover, PA 17331

Sure, I'll try the world's most comfortable shoes. Please send me:

___prs. Men's Tan Leather (M242578B) Size/Width____
___prs. Men's Black Leather (M236802B) Size/Width____
___prs. Men's Brown Sueded (M242586B) Size/Width____
___prs. Women's Tan Leather (M203562B) Size/Width____
___prs. Women's Black Leather (M203687B) Size/Width____
___prs. Women's Brown Sueded (M223784B) Size/Width____

for just **$14.88** pr., plus $2.90 per pr. postage and handling. **SAVE MORE!** Order Two pair for just $28.99 plus $5.00 postage and handling.

CHARGE IT: ☐ VISA ☐ Diners' Club ☐ Carte Blanche ☐ American Express ☐ MasterCard
☐ Enclosed is $______
Acct. #______ Exp. Date____
PRINT NAME______
ADDRESS______
CITY____ STATE____ ZIP____

Our policy is to process all orders promptly. Credit card orders are processed upon credit approval. Delays notified promptly. Delivery guaranteed within sixty days.

© H.H.I. Inc., 1982

American Museum of Natural History
Discovery Tours

GALAPAGOS
ISLANDS
CRUISE
June 5-17, 1982

Discover a naturalist's paradise: a volcanic archipelago straddling the equator and home to unique and tame animals. Share a relaxed holiday aboard the comfortable M.V. Buccaneer with three American Museum curators—all experts in their fields; ornithology/ecology, geology/volcanology, herpetology/evolution. Enjoy superb climate, sandy beaches, fantastic photographic opportunities, and good company. Limited to 65 passengers. For further information write to DISCOVERY TOURS, American Museum of Natural History, Central Park West at 79th Street, New York, NY 10024, or call (212) 873-1440.

else to the images, and so "Life on Earth" is the television equivalent of a coffee-table book. Two conflicting comments can be made about this point. One is that this use of science as mass entertainment is not an inevitable part of television. On the other hand, for several years another series, "Nova," has shown that television science can be not only entertaining but also substantive. Some "Nova" shows are pure entertainment. Others are carefully balanced discussions of science and its discontents.

"Life on Earth" uses an omniscient narrator—Attenborough—to make all its points. But science can be presented as a living and controversial subject only if a lot of people are allowed to speak. This is an issue that is basic to television as a way of telling people things. Any full picture needs what television people call "talking heads." Television directors hate talking heads because the strength of television, its ability to show you things happening, becomes a weakness when nothing is moving but a speaker's lips. Hatred of talking heads explains many of television's peculiarities. Directors will put on almost any scrap of film or send reporters almost anywhere to avoid a prolonged period during which someone looks straight into the camera. Similarly, in "Life on Earth" Attenborough is generally a voice heard while we watch an image. When he is actually seen, it is always in action: riding to the bottom of the Grand Canyon on a mule, snorkeling in the tropics, clambering up a mountainside, or—in a sequence that was the hit of the series when it was presented on British television—romping with the members of a family of mountain gorillas in Africa.

A reviewer, who has to watch the series in a concentrated dose, cannot say how this picturesque use of Attenborough will affect the viewer who sees one show a week. One minor note is that prolonged exposure to Attenborough's Oxbridgean singsong can be annoying to American ears. Long exposure to the musical background can also be irritating; the music is so insipid that it is surprising to learn that someone composed it.

Someone obviously made a corporate decision to focus on Attenborough as the hero of the series. (The television term for these up-front people is amusing at first hearing: they are called "talent.") It had to be a corporate decision because there were big money plans for this series—plans that went somewhat awry.

There is the book, of course, but that is small potatoes compared to the plans originally made for "Life on Earth" in the American television market. The people who paid for the show wanted to get it on commercial television. They produced a brochure that used the hard sell: "Because of the universality of its appeal the series combines the prospect of a high penetration of the network prime time audience in the 5–45 age groups with unrivaled after-market promotional opportunities through A/V [audiovisual, for the uninformed] use in schools linked with specially prepared classroom materials. . . . The series offers unique potential long-term value to the national advertiser."

Unfortunately, no national advertiser appeared. The reason for the nonappearance is probably known only to readers of the trade press and sociologists of television, but an outsider must assume that the series, attractive though it is, was not judged suitable competition for "Monday Night Football" and "CHiPs." There were reports in Britain that the producers toyed with the thought of replacing Attenborough with someone more salable in the American market—Robert Redford, for example—but the reports were denied and Attenborough it is. The series is on public television, under the odd auspices of station WQLN of Erie, Pennsylvania.

The inside talk has to be dredged up because "Life on Earth" must be judged as a part of television. Five years ago, all criticisms would have been submerged under the wave of gratitude for having this sort of show on the air at all. These days television has discovered the value of science as mass entertainment. "Life on Earth" is not being compared to "Happy Days" or "Charlie's Angels" but to "Cosmos," "Universe," "Nova," and other science shows.

"Life on Earth" is beautiful, thorough, accurate, and nonprofound. Its subtitle is "A Natural History," and there cannot have been many illustrated natural histories that can match its visual splendor. It is pleasant entertainment, possibly valuable if it excites some of its viewers into a further interest in the subject. It is better than most of the shows on television today; seeing what has happened to books, it is better than most of the books in paperback racks today. It is as attractive and filling as a cartful of cream pastries.

Edward Edelson is the science editor of the New York Daily News *and the author of several books.*

The Mark of a True Book Lover

Sale!
SAVE
25%

This is the same heavy duty, chrome plated embosser used by professional librarians to mark and identify books.

Now you can have one with your own name and initials on a 1½" diameter seal. It's easy to use. . . simply insert the page, squeeze the handle and "LIBRARY OF (your name)" and initials will be clearly embossed (see photo).

Actual Size 1½"

Thousands sold at $20 or more!

Now Only $14.95 ea.

This quality embosser is fully guaranteed and comes with a handsome storage pouch.

A great gift for all book lovers. . . including yourself!

Please allow 3 to 5 weeks for delivery.

How do you want your seal to read?

Print name and initials below exactly the way you want them to appear

NAME

INITIALS

For additional embossers, simply print names and initials on a separate sheet of paper.

Check One

☐ A check or money order is enclosed
☐ Please charge this purchase to:

☐ VISA ☐ Card ☐ MasterCard

Account #

MasterCard
4 digits above your name

Exp Date ________ Signature ________

BARNES/SALE
& NOBLE/ANNEX
126 FIFTH AVENUE DEPT. E 53
NEW YORK, N Y 10011

Please send me ______ embosser(s) at only $14.95 each plus $1.75 each for postage and insurance. (N.Y. and N.J. residents: Please add sales tax.)

Name ________
Address ________
City ________
State ________ Zip ________

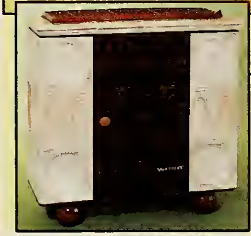
Offer good only in the continental U S A 0038158
© 1981 Barnes & Noble Bookstores, Inc.

Kăch́-ĕl-ōfen.

Kachelofen. Fashioned by skilled artisans of masonry and ceramic tile, these stately, magnificent central heaters have warmed Alpine homes for 700 years. Housed in museums and castles throughout Europe, they are viewed as national treasures.

The WESO Ceramic Tile Stove from Germany is a direct descendant of Europe's mighty kachelofens. The WESO's cast-iron firechamber is surrounded by thick, hand-glazed ceramic tile which captures and releases the fire's warmth far better than metal could.

The WESO burns wood or coal and offers every efficiency feature you could ask for. Its beauty is breathtaking. Choose from 7 decorator tile colors, and enjoy the WESO's visible fire and all-over warmth. **We have stoves for immediate delivery.**



At last. An efficient woodstove beautiful enough for your home.

Rush me your literature portfolio by first class mail, featuring the WESO in all seven tile colors, complete performance data, details on WESO's new coal stove, and current shipping schedule. Enclosed is $1 to help cover mailing costs.

Name ________
Address ________
________ Zip ________

Ceramic Radiant Heat
603/524-9663

2921 Pleasant Drive
Lochmere, N.H. 03252

For Cuisine and Country

Gastronomes and food scholars unite!

by Raymond Sokolov

The elderberries were in fruit when I traveled to England this fall for the Oxford Symposium on National and Regional Styles of Cookery. Much has changed in Britain since I lived there nearly twenty years ago, but apparently there will always be an English countryside. Pristine pastures still stretch away from the train window as one creeps from Didcot to Oxford, the view unmarred by anything less agricultural than dew-drenched sheep.

At Saint Anthony's College, where the symposium took place in a handsome modern building, agriculture was very much a live issue. The 200-odd participants, assembled from as far as Japan and as near as Saint Anthony's itself, voted with unanimity to deputize their leader to press the Common Market, in a formal and sharply worded telegram, to redraft agricultural regulations so as to protect traditional methods of food production.

The man behind this militant meeting of gastronomes and scholars of the edible had just the right mixture of credentials, political and culinary, for his appointed task. Alan Davidson, former British ambassador to Laos and the founder of a learned little food magazine called *Petits Propos Culinaires*, knows his Whitehall as well as his onions. As a diplomat, he traveled the world, implementing official policies and studying fish, an avocation that led to several thorough books, notable for their ichthyology as well as their collections of traditional recipes—Asian, Mediterranean, and most recently, North Atlantic.

Davidson, bemedaled and bedecked in Laotian costume, agreed happily to lobby for the survival of Devonshire clotted cream, farmhouse hams, and other old-fashioned specialties endangered by well-meant new legal standards. *Eminence grise* of the symposium, he took a back seat in the upstairs conference room while Theodore Zeldin, Oxford's distinguished historian of French society, presided over two days of creatively anarchic discussions, which ranged from Maori earth ovens to the semiology of the contemporary Japanese table.

At the opening lunch, participants contributed examples of the foods of many nations. This was no ordinary covered-dish affair, since among the volunteer ethnic cooks were such well-known food writers as Pamela Roden, an expert on Middle Eastern cookery; Elizabeth Ortiz, author of cookbooks on Latin America; and generalist *becs-fins* such as Paul Levy of the *Observer* and Caroline Conran of the London *Sunday Times*. The substance of the symposium, quite apart from the quiches and duck and Bulgarian dessert couscous, consisted of three volumes of papers written by contributors, printed by the Oxford University Press, and possibly still available from the publisher of *Petits Propos Culinaires*, Prospect Books (45 Lamont Road, London SW10 OHU). As someone who has been gnashing his teeth in public for almost a decade over the absence of solid scholarship in the history and ethnography of food, I fell upon these yellow paper-bound tomes with a zest.

Bettmann Archive

Darius is depicted on a fifth-century B.C. bas-relief at Persepolis.

Intellectually, the most advanced and well-researched group of papers came from a cadre of French scholars at the Ecole des Hautes Etudes en Sciences Sociales led by Prof. Jean-Louis Flandrin. His student Jane Cobbi spent several years in Japan working out her analysis of the peculiar system the Japanese use to order a meal. It develops that the assortment of dishes presented on a tray to the diner is determined by the method of cookery employed for each dish. In other words, a proper Japanese meal will include an example of raw food, such as sushi, as well as something grilled, something pickled, and so on. Such elaborate service is rarely seen in Japanese restaurants in the West, which tend to specialize in one style of cooking or another. Perhaps this has happened because restaurateurs suppose that uninitiated non-Japanese diners would not take so easily to the inevitable mixture of hot and cold foods that the fuller

EXPLORE THE DESERT AT THE POST OFFICE.

Come take a look at some beautiful desert plants. Desert plants you don't have to be afraid to touch.

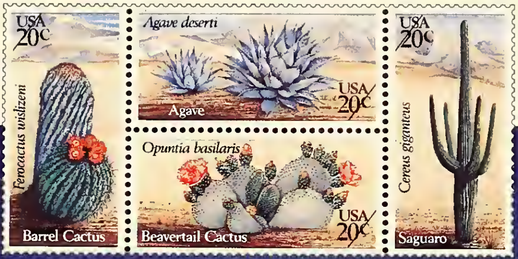
Because they're on the latest U.S. Commemorative block of four.

Each of these plants was an important source of food, water or building material for the Indians.

But that's just one small part of the America you can begin to explore through U.S. Commemoratives. Every few weeks, another new issue honors this country's beauty, history, and heroes.

As you collect them, you'll discover the America you may never see on your own.

So come to the Post Office. And discover stamp collecting. Once you pick up the desert plants, you're sure to thirst for more.


USA 20c
Ferocactus wislizeni
Barrel Cactus
Agave deserti
USA 20c
Agave
Opuntia basilaris
USA 20c
Beavertail Cactus
USA 20c
Cereus giganteus
Saguaro

U.S. Postal Service

© USPS 1982

standard presentation entails. Our own dish-by-dish, cold–hot–cold alternation is also far easier to manage. Indeed, Western dining has only evolved from a "Japanese" sort of smorgasbord system of service to its current course system within the last century.

Quite understandably, many of the symposium contributors confined themselves to describing particular national or regional menus or recipes without attempting to show how these separate foodstuffs and food ideas may have coalesced into a national or regional food style over time. It is probably too early in the history of their discipline for food historians to have gathered enough evidence to be talking with solid authority about complex processes occurring across centuries and leaving few documentary traces behind.

In our food-conscious society, awash with print records of every sort, we can point to documentary evidence of, say, the invention of pie à la mode or the spread of fast-food restaurants. It is another matter altogether to be sure of even the simplest facts of gastronomic history before this century, even in Western countries. Philip and Mary Hyman, two American students of Flandrin's, have produced impressive statistical evidence that certain French culinary regional designations such as "périgourdine" referred, in the eighteenth century, to roughly the same notions of regional foods that the terms convey in modern cookbooks. The Hymans are careful to refrain from implying that these famous "regional" dishes were actually prepared in the regions themselves, then or now. Some clearly were and are. Others were the fantasy creations of Parisian or noble chefs who fastened on a colorful and seemingly appropriate regional name. The evidence for deciding which dishes are truly regional is scanty and sporadically available, because food history was not seriously practiced before the modern interest in things regional captured the interest of urban intellectuals.

Not all the contributors to the symposium limited themselves as rigorously as the Hymans to a narrow, manageable focus. Raphaela Lewis begins her survey of Turkish cuisine by stating baldly that "the influence of the Turkish style was extended, by Seljuk and Ottoman conquests into Asia Minor and Persia, into Greece and the Balkans and across North Africa, and by the Moguls into North India, and the influence persists to this day." Lewis means what she says: half the world, from Bombay to Fez, eats Turkish-style food. And in some rough, general sense this may indeed be true. Well-established facts of Turkish conquest and cultural imperialism support the notion. But Lewis's thesis would be much stronger if it were buttressed with hard facts about the transmission of actual recipes from, for example, Turks to Persians. It seems certain that at least some of the foods of Iran did not originally come from Turkish kitchens. This would almost have to be the opinion of another symposium contributor, Iranian specialist Joyce Westrip, who traces the gastronomic influence of what she calls Persian food on India.

Westrip shows quite convincingly how Parsee (Zoroastrian) refugees and Islamized Mongol (Mogul) conquerors brought their foods to India, where they now enjoy widespread popularity and have been adapted to the cuisines of various ethnic groups. So far so good, but why insist on lumping these foods together as Persian. The term has a quaint whiff of pre-Pahlevi imperialism to it, and even if Iran were still called Persia, as a label for the horrifically complex evolution of diet since the days of Darius and Xerxes, "Persian" obscures more than it clarifies.

Such questions are not mere nomenclatural quibbles, however, and they have, or will some day have, a real purpose. Eventually, as fieldworkers gather enough recipes and other food data to establish firmly the boundaries and identities of the major cuisines of the world, the grander business of tracing the migration of food ideas from one place to another will commence in earnest. We are now only at the beginning of the history of food history. The chief importance of the Oxford meeting was to make this clear and to point the way toward the work that must be done if traditional food knowledge is not to vanish undocumented into the haze of the disregarded past.

Raymond Sokolov's new book, Fading Feast (Farrar Straus and Giroux), *is a collection of food columns that first appeared in* Natural History.

Indian Recipes Exhibiting Persian Influence (adapted from an article by Joyce Westrip in the *Proceedings of the 1981 Oxford Symposium on National and Regional Styles of Cookery*).

Shir Berenj
(Rice pudding)

¼ cup rice
3 cups milk
¼ teaspoon salt
1½ tablespoons sugar
2 tablespoons rosewater
Cinnamon
Honey or sugar

1. Wash rice well, drain.
2. Bring rice and 1 cup water to boil in a large saucepan. Lower heat and simmer slowly, covered, for 25 minutes or until most of the water has been absorbed.
3. Add milk, salt, sugar, and rosewater. Bring to a boil, reduce heat immediately to avoid overflow, then simmer for 25 minutes, uncovered, until milk is absorbed and rice is creamy. Toward the end of this process, lower heat and stir to prevent burning.
4. Pour rice into a serving bowl and decorate with cinnamon. Serve hot or at room temperature, with honey or sugar on the side.

Yield: 6 to 8 servings

Akoorie
(Parsee-style scrambled eggs)

2 tablespoons butter
2 tablespoons oil
6 medium onions, peeled and sliced
Leaves of 4 fresh coriander sprigs, chopped
8 fresh green chilies, chopped
3 medium tomatoes, diced
2-inch piece fresh ginger, peeled and finely chopped
1 dozen eggs
Salt
3 tablespoons milk

1. Heat the butter and oil in a skillet. Then sauté the onion slices until golden brown. Remove and drain one-third of the onion. Remove skillet from heat.
2. To the onion remaining in the skillet, add three-quarters of the coriander leaves, the chopped chilies, two-thirds of the diced tomatoes, and the ginger.
3. Beat the eggs lightly with the salt and milk in a bowl. Then add to the onion mixture in the skillet and cook over low heat, stirring constantly until scrambled.
4. Transfer to a serving platter immediately, garnish with reserved onion, tomato, and coriander.

Yield: 6 to 8 servings

"Cloning the sun's fire could mean a billion years of energy."

"Nuclear fusion is the energy source of the sun and the stars, and if we can reproduce that process on earth, we'll have energy for a billion years," says Dr. Tihiro Ohkawa, Vice President for Fusion Power Research at General Atomic Company, a subsidiary 50% owned by Gulf Oil Corporation.

"Our research programs, sponsored by the Department of Energy and others, could lead to construction of an experimental fusion reactor within a decade.

"Both fusion and conventional fission reactors produce heat, which can, for instance, generate electricity. But fusion produces less radioactive waste than fission. It can't get out of control. And it uses cheaper fuel—hydrogen instead of uranium. In fact, fusion reactors can make fuel for fission reactors, and possibly could even burn the fission reactors' wastes.

"It's a tremendous technological challenge, but the reward is tremendous, too: inexhaustible energy for tomorrow."

Gulf

Gulf people:
energy for tomorrow.

© Gulf Oil Corporation 1981.

THE TASTE BEYOND 12-YEAR-OLD SCOTCH

The
GLENLIVET
AGED 12 YEARS
GEORGE & J. G. SMITH
ESTABLISHED 1824
The GLENLIVET
AGED 12 YEARS
BOTTLED IN SCOTLAND
The
GLENLIVET
12 YEARS OLD
Unblended all malt
Scotch Whisky
Distilled and Bottled in Scotland
GEORGE & J. G. SMITH LIMITED
THE GLENLIVET DISTILLERY · GLENLIVET SCOTLAND
U.S. IMPORTERS
THE GLENLIVET DISTILLING COMPANY
NEW YORK, N.Y.
750 ML. (25.4 FL. OZ.) 86 PROOF
12 YEARS OLD
THE GLENLIVET
SCOTCH WHISKY

Discover more.

Let your mature taste lead you from the finest premium Scotch on up to the most expensive 12-year-old Scotch in the world. The Glenlivet. The ultimate in Scotch.

Most premium Scotch is blended and depends on several whiskies for taste and smoothness.

Yet the unblended character of The Glenlivet is noble enough to stand alone. In this distinctive Scotch whisky you'll experience an exceptional smoothness and full-bodied richness, unmatched in all other premium Scotch.

Try the taste beyond premium Scotch.

The Glenlivet
Unchanged since 1824.

NATURAL HISTORY

$2

2/82

INTERESTED IN A DIESEL THAT CAN DELIVER THIS KIND OF MILEAGE?

Traditionally, diesel engines have been known to last a long time. (Their high internal pressures require rugged construction.)

Traditionally, Volvos have been known to last a long time. (Our high internal standards require rugged construction, as well.)

It only makes sense then that a diesel-equipped Volvo is designed to deliver more than a good EPA number.* It should deliver a good number of years.

We can't guarantee you'll rack up a hundred thousand miles on your Volvo. But chances are you won't end up having to trade it in just about the time you're done paying for it, either.

Of course, owning a car that will be around for many miles doesn't mean much unless driving them is an absolute pleasure. So Volvo provides its GL Diesel Sedan with amenities such as an electrically heated driver's seat. To get you comfortably through all those long winters to come.

A twelve vent air conditioner. To get you comfortably through all those sticky summers to come.

Even a sun roof. Just to get you comfortably through all the temperatures in between.

The choice is simple. If all you want is better mileage, you can buy any diesel.

And get quantity.

Or you can buy a Volvo. And get something substantially more impressive.

Quality.

VOLVO
A car you can believe in.

29 EPA EST.* **37** EST. HWY.* *The Volvo 4-door diesel sedan and wagon with manual transmission and overdrive. Use these numbers for comparisons. Actual mpg may differ depending on speed, trip length and weather. Actual highway mpg will probably be lower than EPA highway estimate. © 1981 Volvo of America Corporation

TO FLY

An irresistible
film fantasy in
the Museum's new
Naturemax Theater

Get Your
FREE
TICKET

as a Member of
the American Museum
of Natural History

*See other part
of this card*

NATURAL HISTORY

Vol. 91, No. 2, February 1982

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director

2 Authors

4 Appalachian House Beautiful *Charles E. Martin*
Newspapers were satisfactory for papering walls, but magazines were better, of course.

19 This View of Life *Stephen Jay Gould*
Nonmoral Nature

28 Enchantment of the Fasnacht *Donna Lauren Gold, photographs by Alexander Orloff*
For a few sleepless nights and days, the rules of a staid, orderly Swiss city are changed.

---

41 The Coming Solar Age *Lester R. Brown*
A special Natural History *supplement on a future that is practically here.*

---

57 Giving Life to Ancient Bones *Sylvia Massey Czerkas and Donald F. Glut*
During his lifelong association with the American Museum of Natural History, a Brooklyn-born artist created our image of prehistory.

62 Wild White Sheep *George Wuerthner, photographs by Johnny Johnson*
Winter is the cruelest season for the dominant rams of these Alaskan herds.

70 Whooper Recount *Paul A. Johnsgard*
Total numbers reveal only part of the endangered crane's fate.

76 Celestial Events *Thomas D. Nicholson*

78 Books in Review *Niles Eldredge*
Evolutionary Housecleaning

82 Sky Reporter *Stephen P. Maran*
Quakes on the Moon

88 Additional Reading

90 A Matter of Taste *Raymond Sokolov*
Maryland Is for Crabs

94 At the American Museum
The Naturemax Theater

Cover: *During the annual Fasnacht, one of the traditional masquerade groups steps in tune along a cobblestone street in Basel, Switzerland. Photograph by Alexander Orloff. Story on page 28.*

Alan Ternes, Editor
Judith Friedman, Managing Editor
Thomas Page, Designer
Board of Editors: Carol Breslin, Sally Lindsay, Frederick Hartmann, Vittorio Maestro, Rebecca B. Finnell
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
E. Kay Danzig, Art Asst.
Kay Zakariasen, Picture Editor
Lauren Krenzel, Photo Research
Douglas J. Preston, Publications Editor
Annie R.C. Finch, Editorial Asst.
Lillian Berger
Editorial Advisers: Malcolm Arth, James W. Atz, Niles Eldredge, Kenneth L. Franklin, E.Craig Morris, Norman Newell, Thomas D. Nicholson, Martin Prinz, Gerard Piel, Nina Root

David D. Ryus, Publisher
Bradford D. Smith, Business Manager
Frederick E. Grossman, Production Mgr.
Debra Buck McCord, Asst. Production Mgr.
Ernestine Weindorf, Administrative Asst.
Elaine M. Callender, Advtg. Production Mgr.

Cary Castle, Circulation Manager
Jeff Pieper, Assoc. Circulation Mgr.
Ramôn E. Alvarez, Asst. Circulation Mgr.
Frank Stevens, Circulation Asst.

NATURAL HISTORY *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Subscriptions: $15.00 a year. In Canada and all other countries: $18.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.* *Copyright © 1982 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of* Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.* Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

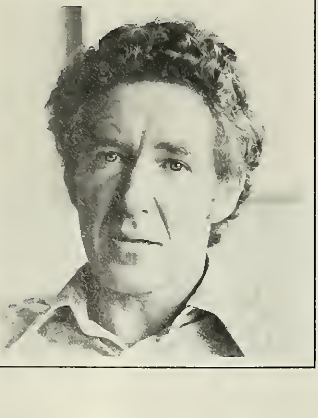
Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225
Subscription Orders (800) 247-5470
(800) 532-1272 (in Iowa)

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

Authors

Donna Lauren Gold first heard about the colorful Fasnacht, Basel's annual carnival, when she was living in Zurich, Switzerland, and working as the overseas officer of a small American publishing company. A year or so later, while working toward her master's degree in anthropology at the New School for Social Research, she traveled to Switzerland to investigate the carnival herself. Interested in the convocation of groups of people who have little to do with one another on a day-to-day basis, Gold also enjoys experiencing the energy and immediacy of such celebrations. She is continuing to do research on festivals and gatherings of all sorts as she pursues a career as a free-lance writer.

Lester R. Brown is president of the Worldwatch Institute in Washington, D.C., a privately financed research group established in 1975 to analyze such global problems as pollution, conservation, population growth, energy supplies, and food production. Brown, who has degrees in agricultural science, economics, and public administration, formerly served in the U.S. Department of Agriculture, where he coordinated technical assistance programs in some forty countries. He is the author of seven books; the most recent is *Building a Sustainable Society*, published in late 1981 by W.W. Norton and Co., from which the article in this issue was adapted. Brown has lectured widely and his articles have been published in numerous newspapers and magazines in the United States and abroad.

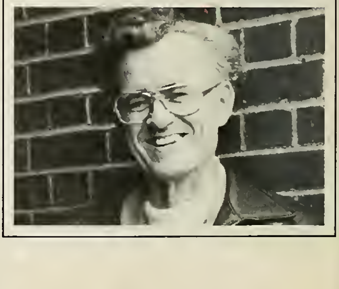


Sylvia Massey Czerkas has been a professional artist and sculptor of animal life for thirteen years, with a special emphasis on dinosaurs. Her work has been shown in galleries and museums throughout the United States. While doing research on dinosaurs, Czerkas was impressed by the beauty and accuracy of Charles Knight's work and began a serious study of the artist and his life. She is currently coproducing a documentary film on dinosaurs with her husband, special effects artist Stephen Czerkas.

Coauthor **Donald F. Glut** (not shown) grew up in Chicago and was a frequent visitor at the Field Museum of Natural History, where he was exposed to the paintings of Charles Knight, as well as some fine paleontology exhibits. Glut, who has a bachelor of arts degree in letters, arts and sciences from the University of Southern California, has just finished *The New Dinosaur Dictionary*, which will be published in 1982.

A wilderness enthusiast, **George Wuerthner** has kayaked down the Yukon River and along the Alaskan coast on a four-month-long jaunt. He has also backpacked in the Brooks Range for as long as a month at a time. His experience in the wilds of Alaska includes stints as a ranger in the Gates of the Arctic National Park and as a photographer with the Bureau of Land Management. On all of his excursions, he has taken the opportunity to observe Dall's sheep. Wuerthner has a degree in zoology from the University of Montana and is currently pursuing studies in botany.

Paul A. Johnsgard became interested in whooping cranes after moving to Nebraska and learning of the species' past abundance in the Platte Valley. While preparing a book on crane biology, he noticed that the population dynamics of cranes are different from those of other bird groups he had studied. The whooping crane represented a unique source of data because for nearly half a century the species' entire population has been censused annually. Foundation Professor of Life Sciences at the University of Nebraska, Johnsgard is at work on several books; among them are *Hummingbirds of North America*, to be published by Smithsonian Institution Press, and *Teton Wildlife*, to be issued by Colorado Associated University Press.



Old Bushmills.
It's changing people's minds about Irish Whiskey.

IMPORTED
FROM THE WORLD'S OLDEST DISTILLERY
OLD BUSHMILLS
IRISH WHISKEY
TRADE MARK
ORIGINAL GRANT
1608

A blend of [illegible] Irish Whiskeys. [illegible] proof. Bottled in Ireland. The Jos. Garneau Co., New York, NY ©[illegible]

For free food and drink recipes, write to Old Bushmills, P.O. Box 639, New York, New York 10018. To send Old Bushmills anywhere in the country, call toll free: (800) 528-6148. Void where prohibited.

Experience the taste that experience created. Old Bushmills. Since 1608.

Appalachian House Beautiful

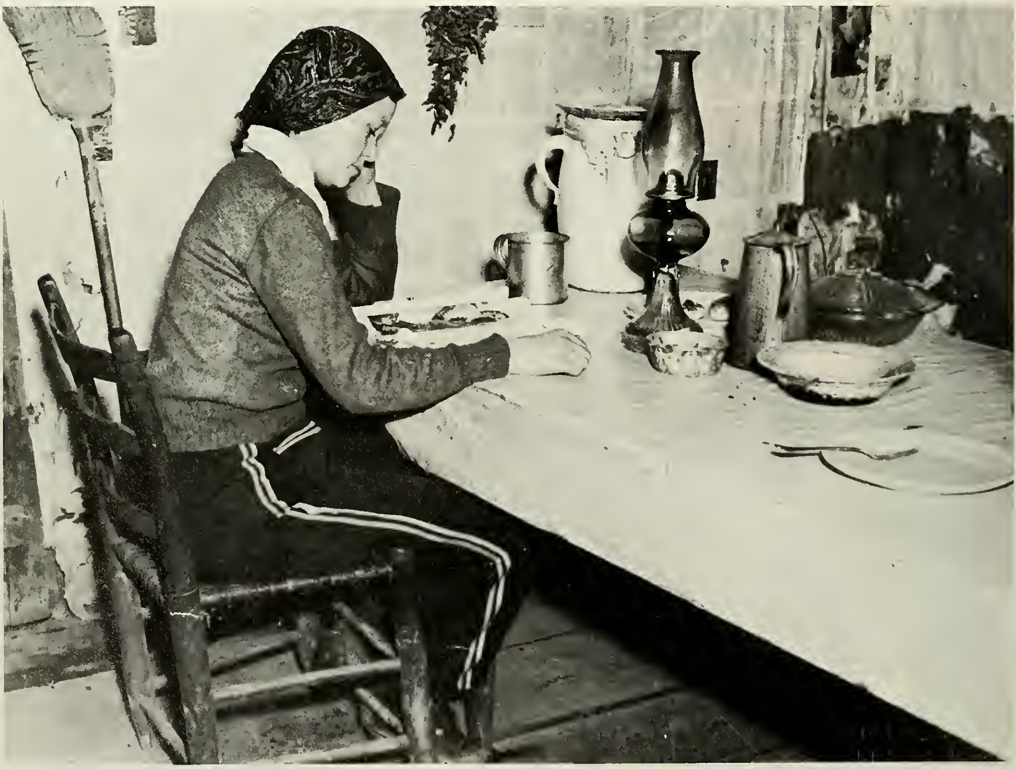
The older generation looks back with nostalgia on walls papered with newspapers, magazines, and mail-order catalogs

by Charles E. Martin

In parts of Appalachia, especially in eastern Kentucky, traditional folk housing was rarely trimmed with ornate woodwork, perhaps in deference to the aesthetics of the well-shaped hewn log, often twenty feet long, two feet high, and carefully thinned with ax and adz to a uniform thickness of six inches. Still, during the early part of this century the impulse to individualize, personalize, and decorate found expression. One former log-house builder tells how he rounded the top of his rectangular chimney because "it was prettier that way, nicer to look at." By the 1930s, log houses were sometimes covered on the outside with milled wood, so they would resemble the more fashionable board-and-batten house. Builders who used new or freshly painted roof tin thought it extremely attractive. Almost all houses had either day lilies, apple rose (usually planted by the well), tulips, or roses growing somewhere close by. But the most important method of decorating, in terms of wide appeal and individualization, was the papering of interior walls with newspapers, catalogs, magazines, or some combination of the three.

This practice, by and large the province of women, was the norm from at least 1900 until the 1940s, when commercial wallpaper first became available in parts of eastern Kentucky. More affordable than paint, properly applied

In the 1930s, the good housekeeper papered her walls periodically.



Alice Lloyd College Photo Archives

Excerpted from Hollybush: Folk Building and Cultural Change, © *by Charles E. Martin, to be published in 1982 by University of Tennessee Press.*

FIRST CLASS TRAVELERS

No matter where your journeys take you, this year you can travel first class. Because this year, Lincoln-Mercury has a wagon with the comfort features and amenities sized just right for you.

MARQUIS, 53	CUBIC** FEET	17	*EPA EST. MPG	26	EST. HWY.
COUGAR, 42	CUBIC** FEET	19	*EPA †EST. MPG	26	EST. HWY.
LYNX, 28	CUBIC** FEET	28	*EPA EST. MPG	44	EST. HWY.

Lynx, of course, is the mileage leader of American wagons and has a special inner world for your passengers and your cargo. There's the mid-sized Cougar wagon, marked by its distinctive grille, generous capacity, and individualized interior. Plus the 1982 Marquis wagon, which offers traditional space with contemporary mileage.

Visit your Lincoln-Mercury Dealer and find your wagon. You'll find it's the difference between coach and first class.

LINCOLN-MERCURY DIVISION Ford

MARQUIS, COUGAR, AND LYNX FROM LINCOLN-MERCURY

*Compare to the estimated MPG of other cars. Your mileage may differ depending on speed, weather, and trip length. Actual highway mileage probably lower. †With optional 3.8-liter engine. **Based on EPA Interior Volume Index figures. All comparisons exclude other Ford Motor Company products. Buy or lease from your Lincoln-Mercury Dealer.

What your home could have in common with the Met, the Tate, and the Louvre.

Elaine Simel's, *Orchids I*, original etching.
Signed limited edition of 175.

Beautiful, original works by artists who are represented in the world's great museums and galleries can be yours for very reasonable prices.

We offer original etchings, lithographs and serigraphs signed by Calder, Chagall, Dali, Miró, Renoir, Vasarely and other important artists.

Elaine Simel's delicate etching, *Orchids I*, is one of the many fine prints we've made available.

Our expert advice and full money-back guarantee are your assurances that the art you buy will have lasting value and beauty.

Send for our colorful, descriptive catalogue, without obligation.

Visit our new gallery located at 215 Lexington Avenue, Mon–Fri, 9–5 PM. Telephone: 212-685-9400 Ext: 35

© 1982 OPCG, LTD

Original print collectors group, Ltd.

215 LEXINGTON AVE.,
DEPT. NH-36, NEW YORK 10016

PLEASE SEND ME YOUR FREE COLOR CATALOGUE WITHOUT OBLIGATION.

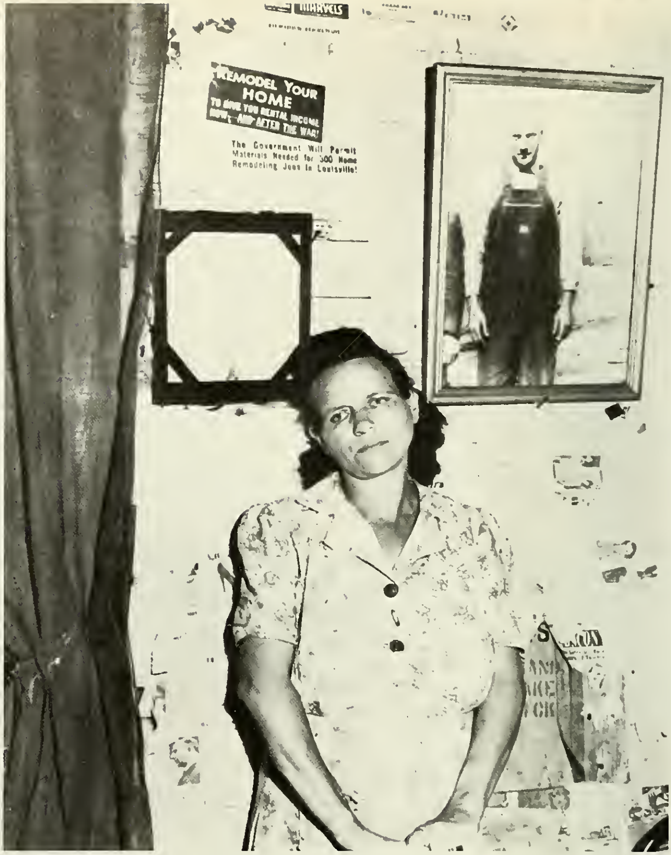
NAME ____________________
PLEASE PRINT

ADDRESS ____________________

CITY ____________________

STATE ____________ ZIP ____________

Alice Lloyd College Photo Archives


REMODEL YOUR HOME
TO GIVE YOU RENTAL INCOME NOW, AND AFTER THE WAR!
The Government Will Permit Materials Needed for 300 Home Remodeling Jobs in Louisville!

A photograph of her husband hangs on a Kentucky widow's papered wall.

paper also doubled as insulation, sealing the small cracks and openings that formed between the logs and mud chinking or between the boards and battens. Although outsiders may have regarded walls papered this way as symbols of neglect, the application of printed pages was quite orderly and upheld the longstanding Appalachian custom of recycling nonfunctioning machine-made objects. Worn-out shoes, for example, became hinges, and empty leather lard buckets were turned into stools or cut into strips and used for chimney flashing.

A log wall was prepared for papering by applying a layer of heavy paper or cardboard to smooth out uneven surfaces. Large holes were filled with wads of rolled paper or burlap because as the paste dried, the paper would split over any openings (and children had a tendency to stick their fingers through such places). A board-and-batten house had straighter walls and did not need as much preparation, only the cardboard undercoating to serve as insulation and as backing. On the other hand, to prepare a previously papered wall, the paperer might want to strip off some of the earlier layers.

Paper saved for wall covering was applied with a paste made by boiling water and flour. The paste was thin enough to spread evenly but too thick to run down the walls, and lumps were carefully broken up either by hand or with a short broom. To keep mice from eating the paste, red pepper and rat poison were sometimes added. The dried roots of sweet anise and arrowroot, which grew along the high ridges of the region and have a licorice taste, were ground to a fine powder and added to the paste to give it a sweet aroma. The act of papering itself was thought to give a room a fresh smell as well as a fresh look.

Usually, if not enough of one type of paper was available to go around a room, then two or more types were used, but they were not mixed haphazardly on the same wall. For example, newspaper might be used on three walls, but if there was not enough to do all of the fourth, catalog paper was substituted.

Each sheet of paper was laid flat on a table, and a small brush was used to dab a little paste in the corners, around the edges, and once or twice in the center. The sheets were then applied, beginning in one of the corners of a wall. As each sheet was added, either in horizontal or vertical sequence, particular attention was paid to keeping the borders straight and to overlapping the previous page by about an inch. If the lines were not uniform, a papered wall was not considered attractive. Any paper that overlapped the edge of the wall was carefully trimmed with scissors or pocketknife.

Newspaper and catalog paper were of the same light weight and needed to be papered over frequently because of fading and discoloration. One woman remembers her father saying he needed to rush home before the dress styles in the paper pasted to the walls changed again. Nevertheless, newspaper did have an advantage. If sheets without photographs were chosen, the white background dominated over the black print and approximated a wall painted white. For this reason newspaper was preferred on ceilings: in an era before electricity, papered ceilings reflected outside light and made a room seem brighter.

Although stray pages with photographs upset the uniformity of a wall or ceiling covered only with print, sometimes paperers deliberately chose newspaper pages with photographs so that the walls would be studded with interesting images. Such preferences were flexible enough to change, though, by the next papering. Pasting newspaper with the print right side up was considered important. Some older, illiterate people could only do this if the pages had photographs, and so they spaced pages with photographs evenly with the all-print pages. If no pages with photographs were available, they would still take care to have the edges absolutely straight, even though the writing might be upside down. A different practice was to cut the pages square and apply

UNSPOILED.

There are few places left on earth that are unspoiled. Sri Lanka is one of them. Once known as Ceylon, Sri Lanka has Asia's best game preserves. 200 species of animals, 425 kinds of birds and hundreds of square miles of leopard, elephant and sambur.

The wild flowers of Sri Lanka include a dazzling display of orchids. And where else could you find 600,000 acres of tea gardens on misty mountains?

There are 75 ways you can tour Sri Lanka. Ranging from 3 to 21 days. Accommodations begin at $5. Deluxe sells for $45. Never has your dollar worked harder. From shopping to sightseeing.

In our ancient cities, you can enjoy frenetic festivals that reflect the unspoiled nature of a culture which dates back 3,000 years.

Whether your visit is pleasure, business or a convention, our unspoiled country will spoil you. Just one hour from India, three hours from Katmandu, Bangkok and Singapore. Write for a color flyer and tour digest that includes special airfare.

sri Lanka
Pearl of the Indian Ocean.

Ceylon Tourist Board/Dept. NH22
609 Fifth Avenue, New York, NY 10017

Name
Address
City/State/Zip

easter eggs

The colors of the rainbow adorn these delicate eggs from Czechoslovakia. Each egg is painstakingly decorated with traditional folk designs — some are drawn with warm wax and dyes, some gaily hand painted . . . all are different! One dozen eggs $19.50 postage paid.

Send $1.00 for our newest catalog of imported fashions and gifts.

shopping international

dept. 506 norwich, vermont 05055

The Wilderness Travel
World of Discovery

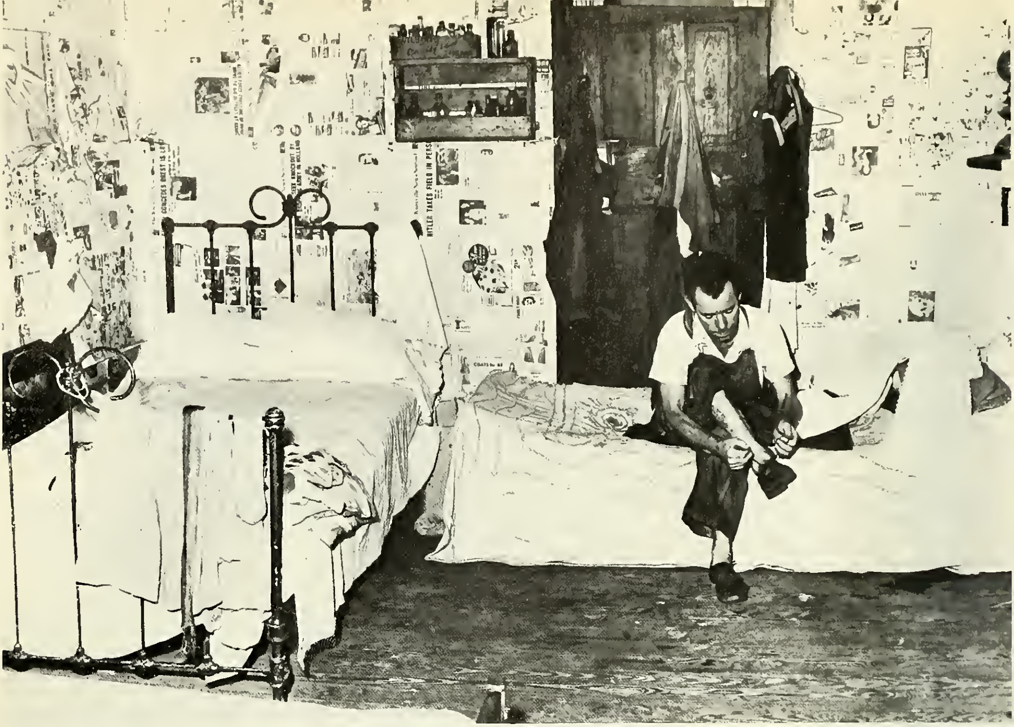
Wildlife & Natural History Tours
Anthropology & Archaeology Tours
Trekking Expeditions
Jungle Exploration

• CHINA •
• Kenya • Tanzania • Galapagos •
• Peru • Ecuador • The Amazon •
• Nepal • Australia •
• Alaska • New Guinea •

Write for our NEW 32-page fully illustrated 1982 catalog

Name
Address
Zip

WILDERNESS TRAVEL
1760-N Solano Avenue, Berkeley, California 94707
(415) 524-5111



Alice Lloyd College Photo Archives

Some paperers would have disliked this nonvertical placement of pages.

newspaper print both vertically and horizontally, either in a checkerboard pattern or in alternating columns. These were called crazy quilt walls.

Newspaper pages without photographs made an ideal bland background for a favorite color magazine picture, pasted in the center of a wall or over the fireplace. Sometimes, to accentuate the focal point even more, newspaper intended for the wall's edges was folded in a back-and-forth pattern, notched on one end with scissors, and then unfolded to form a symmetrical scalloped design. The darker cardboard or paper underneath, showing along the perimeter of the wall, set off this decorative border. This technique was used even without the benefit of a central picture. A border could also be made with magazine pages, chosen as a colorful contrast to the white wall and as an accent to the picture.

Some people placed cartoons and Sunday funnies along the walls at about eye level for the smaller children, who were then able to move around the room looking at one after the other. Since newspaper was replaced frequently, there was always a fresh round of cartoons. Mothers pasted up interesting newspaper articles that they wanted their children to read. Two women I interviewed remember learning to spell Cincinnati from the wall, and another explained that all her children learned the alphabet by playing a game in which one of them would select a letter on the wall and the rest would try to find that particular letter by following the instructions given by the first child. Variants of this game were played with colors or subjects on the magazine and catalog pages.

One woman made a special point of pasting newspaper poems where she could read them while she worked. She had acquired this interest from her father, more than sixty years before: "I learned a many of a poem right off the wall when I was a little girl. Me and my dad learned poems off the wall when I was nine years old. [One] was right up over the table where we ate, and he told me, 'Let's me and you see which one can remember this the longest'; and he's been dead about ten years. He remembered it the last time I talked to him, and I remembered it, too. It tickled me and him. It said,

> 'Foxes could talk if you know how to listen,
> Pa said so.
> Owls have big eyes that sparkle and glisten,
> Pa said so.
> And bears can turn flipflops and climb big elm trees,
> and steal all the honey away from your bees,
> and they don't mind the winter because they never freeze,
> Pa said so.
> Girls is scared of a snake, boys ain't,
> Pa said so.
> Girls run and holler and sometimes they faint,
> Pa said so.
> A boy'd be ashamed to be frightened that way
> when all a snake wants to do is play.
> You've got to believe every word that I say,
> Pa said so.
> They are as fond of a game as they are of a fight,
> Pa said so.
> Most all the animals found in the woods
> ain't all time fierce, most time they're good.

ADVANCE SUBSCRIPTION APPLICATION

The 100 Greatest Stamps Silver Miniature Collection

Valid only if postmarked by February 28, 1982

Limit: One collection per person

The Franklin Mint
Franklin Center, Pennsylvania 19091

Please enter my subscription for The 100 Greatest Stamps of the World collection, consisting of 100 finely detailed sterling silver miniatures, to be sent to me at the rate of two per month, at the guaranteed issue price of $4.75* per miniature. I will be billed for my silver miniatures prior to shipment. I will also receive a custom-designed presentation case, special magnifier and collector's tongs at no additional charge.

**Plus my state sales tax and 25¢ for shipping and handling.*

Signature______________________________
ALL SUBSCRIPTIONS ARE SUBJECT TO ACCEPTANCE.

Mr. / Mrs. / Miss__________________________
PLEASE PRINT CLEARLY

Address_______________________________

City__________________________________

State, Zip_____________________________

THE FRANKLIN MINT IS THE WORLD'S LARGEST PRIVATE MINT. IT IS NOT AFFILIATED WITH THE U S. MINT OR ANY OTHER GOVERNMENT AGENCY.

© 1982 FM

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

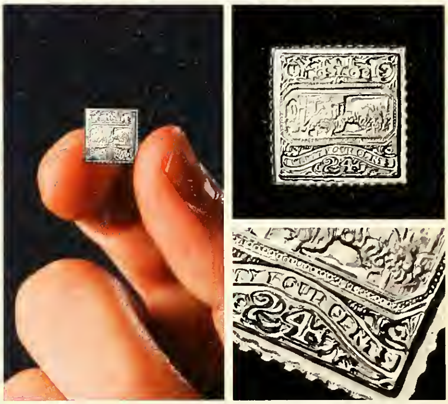
BD

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 1 FRANKLIN CENTER, PENNSYLVANIA

POSTAGE WILL BE PAID BY ADDRESSEE

THE FRANKLIN MINT
Franklin Center, Pennsylvania 19063



The 1869 United States 24¢ Inverted Center is one of the rarest of all American stamps. It bears the famous John Trumbull painting portraying the signing of the Declaration of Independence. But through a printing error, the image is shown upside down on the stamp. (Silver stamp shown at left actual size; at right, enlarged to show fine detail.)

The world's greatest stamps silver miniatures

A complete collection of the 100 most significant stamps ever issued– each portrayed in remarkable micro-detail by The Franklin Mint.

And you can acquire these sterling silver miniature stamps –at just $4.75 each by entering your subscription now.

Your eye is first attracted by the brilliance of silver. But as you look closer, the lines of an intricate design begin to take shape before you. Then, you place the sterling silver miniature under a magnifying glass—and there, in astonishing detail, is one of the world's greatest stamps!

This is the pleasure that awaits you with each new issue of The 100 Greatest Stamps of the World—as you discover the intriguing world of the minted miniature. A world that combines the beauty of solid sterling silver with the fascination of painstaking detail in the tiniest possible area.

This exciting new collection, to be produced by The Franklin Mint, will consist of 100 meticulously crafted miniatures—each one portraying one of the greatest stamps of history.

The rarest and most coveted of all stamps

A panel of distinguished authorities on world philatelic issues has selected, out of the many thousands of stamps issued throughout the world, the 100 greatest of all. And these are the stamps that will be *authentically re-created* for this exceptional —and very beautiful—collection.

Among them are: the British Guiana One-Cent Magenta, which brought the record price of $850,000 at an auction in 1980—the Penny Black of Great Britain, the first adhesive postage stamp in the world—the U.S. 24¢ Airmail Invert, one of the rarest of all American stamps—the Japan 500 mon Dragon, which was first thought to be a forgery but is now a prized rarity. And such famous issues as the Double Geneva, Moldavian Bull, Trinacria of Naples—100 great stamps in all, from every part of the world.

Superbly crafted works in miniature

Each sterling silver miniature will recapture the stamp it portrays with absolute authenticity. You'll actually be able to see every detail of the American biplane which is shown on the 24¢ Airmail Invert. Every feature of Queen Victoria's portrait on the Penny Black. The intricate background pattern that distinguishes the One-Cent Franklin "Z" Grill. The winged headdress on the "Hermes Head" stamp of Greece.

So that you will be able to study and enjoy each miniature in close-up detail, a special *magnifying glass* and *collector's tongs* will be provided. And you will receive a custom-designed *presentation case* to house and protect the complete collection of silver miniatures.

A limited edition at a guaranteed price

You will receive your silver miniatures at the convenient rate of two per month, and the issue price of just $4.75 will be *guaranteed* to you for each miniature in the collection—regardless of inflationary pressures.

Your advance application is valid only until February 28th, and the edition will be permanently limited to the number of subscriptions entered by the end of 1982. After that, it will *never* be offered again.

No payment is required at this time. But be sure to mail the attached postpaid card to The Franklin Mint, Franklin Center, PA 19091, by February 28, 1982.

Share the Thrills of Exploring Outer Space!

$359.95 f.o.b. Hartford, Conn.

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

Criterion Manufacturing Co.
620 Oakwood Ave., W. Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept NH 111
620 Oakwood Avenue., W. Hartford, Conn. 06110
Please send your free Telescope Guide.

Name____________________

Address____________________

City____________ State________

WHEN YOU WRITE TO NATURAL HISTORY

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance. You can use this form to tell us about a move or order a subscription.

Change of address—Attach your address label in the dotted area and fill in your new address below, clip and mail to Natural History Membership Services, P.O. Box 4300, Bergenfield, N.J. 07621.

Cut your old address label from magazine wrapper and attach over this area.
Fill in your NEW address and mail to:
Natural History Magazine
Membership Services P.O. Box 4300
Bergenfield, N.J. 07621

PLEASE PRINT

Name ____________________

New Address ____________________

City ________ State ________ Zip ________

The trouble is mostly they're misunderstood,
because Pa said so.' "

Compared with newspapers and catalogs, magazine paper was heavier, more durable, and more resistant to fading and discoloration by coal dust. The color pages in magazines also made them popular. As one woman remembers,

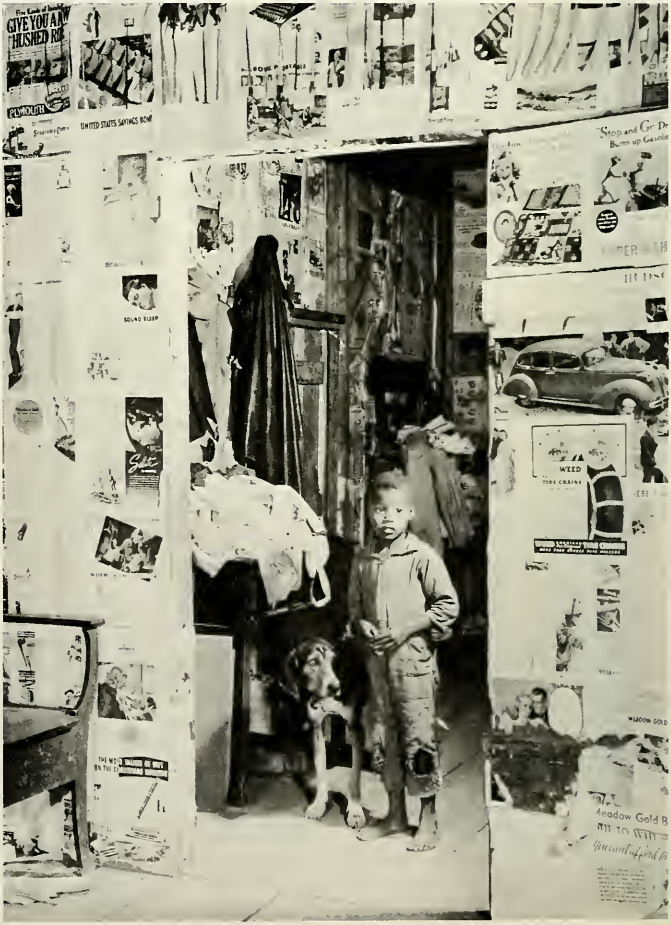
> When I could get a *Life* or a [*Saturday Evening*] *Post* or something, why, they were the most precious ever was, and we'd save them, you know. I'd use them, and they'd last maybe a year and they'd stay white; but newspaper you'd have to paper every two weeks because they'd turn yellow.

After the wire staples were removed, magazine pages were dabbed with paste and arranged on the wall so that the eye would fall on the images to which the paperer was most attracted. In a wall awash with color, the favorite picture, the one neighbors would stop and comment on, was placed in the center. The choice of subject reflected personal preference: Christmas, houses, automobiles, ornately prepared food dishes, and so on. One woman recalls:

> I remember in a farm magazine, one time, when you opened it, it had a picture in the middle. It was a farm, and that was so pretty, I remember putting that over the mantel and then put white around it.

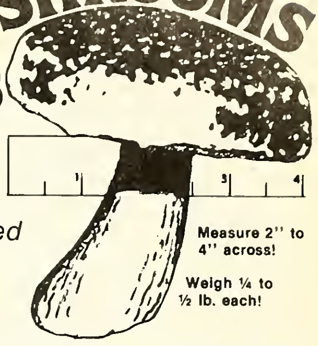
Pictures of flowers appealed to one woman because she thought they ap-

Decorative paper cutouts, such as this fringe in a Louisiana home, were also used in Appalachia.



Ben Shehn, FSA-OWI Collection, Library of Congress USF 33-6018-M2

GIANT GOURMET MUSHROOMS LIKE THESE INDOORS YEAR 'ROUND'



Measure 2" to 4" across!

Weigh ¼ to ½ lb. each!

the majestic Shiitake mushroom - revered by gourmets for its flavor, revered in the Orient as the Elixir-of-Life

by Hal Taub (At Lovin' Spoonful, I'm Chief Cook & Bottle Washer)

Like most Americans, I love mushrooms. Mushrooms on steak...in an omelet...stuffed mushrooms...as part of my salad...mushroom gravy—you name it, I eat 'em up.

When I can afford it!

With the price of mushrooms *mushrooming* to over $2 a pound for the small button type—when you can find them—and the fancy dried imported kind going for $20-$40 a pound and more, I think twice before indulging myself. Is it any wonder that I've even tried growing them myself? What I got for my labors was a handful of tiny buttons, along with some nasty comments and dirty looks from my neighbors. (Our American or "button" mushrooms require large amounts of manure to grow.)

A TASTE EXPERIENCE

Do I love my food? Let's just say that I very seldom miss a meal. Recently, on a business trip to California, I was treated to a business lunch at an absolutely delightful restaurant in Beverly Hills. Of course I ordered a mushroom salad. It was incredible! I had never tasted anything like it before. Not even the imported mushrooms came close. I can only describe the flavor as being somewhere between filet mignon and lobster! I not only ate my salad, I ordered two more to boot. In fact I almost OD'd on mushroom salad!

THEY ARE CALLED SHIITAKE'S

That was my introduction to the Shiitake Mushroom. Let me tell you, I did not leave that restaurant without learning their source. I discovered they were being raised in very limited supply by a Chinese American botanist, Dr. Henry Mee. I called Dr. Mee thinking I could tote a few pounds home with me. He most graciously invited me out to his facilities. I went to buy mushrooms, but instead, received an education.

ELIXIR OF LIFE

The first Shiitake spawned during the misty era of a hundred million years ago. Early chinese sages attributed great powers to the Shiitake and it was often called the Emperor's Food. In ancient China and Japan, it was eaten by royalty to fend off old age, revered as an aphrodisiac and fought over by Japanese warriors who fiercely guarded the growing sites.

In their natural habitat, it takes two years to bring a Shiitake crop to harvest. They grow on oak logs in the remote mountain forests of Japan. After 25 years of study and labor Dr. Mee has developed a method that cuts the time down to 45 days. He now produces some 100 pounds daily, of which the entire crop is taken by a relatively small handful of gourmet restaurants and shops.

MORE THAN I BARGAINED FOR

Rather than sell me a few pounds of mushrooms, Dr. Mee suggested I grow my own. He had perfected his process to the point where he claimed anyone who could water a house plant could enjoy fresh, luscious "Shiitake" mushrooms. Simply stated, he simulates their natural habitat by producing a "log" fabricated of 100% sterilized organic plant material, with nothing artificial, and no chemicals added. The log is then innoculated with pure culture of the "Shiitake" mushroom spore...and then cured or "aged" to hasten fruition under home environment with the addition of nothing but water. When Dr. Mee said I would not require any manure or fertilizer of any kind, I decided to give it a try

SIMPLE AS A.B.C.

The instructions were simple. Start by soaking the log in water for 24 hours. Then simply place the tree in its own wooden planter-stand and set on a foam rubber pad, which is supplied with each log and acts as a moisture "reservoir". After that just mist it once a day. And, unlike buttons, Shiitakes thrive in daylight.

INCREDIBLE RESULTS

In only 5 days I actually saw mushrooms start budding, 10 days later I picked my first giant Shiitake. One month later I had enough for not only myself but my friends as well. What's more, Dr. Mee has informed me that I can expect the log to keep producing for the next 10 to 12 months. If you're growing more mushrooms than you can use, simply store the tree in the frig (or outdoors if the weather is cool) and it will stop growing. When you want more mushrooms, just place it at room temperature and it will start producing.

NUTRITION

With a virtually unlimited supply of my favorite food I've become something of an expert. Mushrooms are nature's unique low cal fat-free food. One pound contains fewer calories than a single apple! Shiitake mushrooms have more than twice as much protein and fiber as common button mushrooms, almost 3 times the minerals. Calcium, Phosphorous and Iron are present in large quantities, as are high levels of B Vitamins and Vitamin D2.

A FEAST

All of this nutrition stuff is great. But the eating is even better! One ounce of Shiitake will equal the flavor of an entire pound of buttons. They are super meaty, super mushroomy in taste, succulent, heady and 100% edible from cap to stem.

One of two slices turn an ordinary pot roast into a gourmet delicacy...an ordinary salad into an extraordinary taste sensation...a gravy into a nectar for the gods. And spaghetti; let me tell you about my spaghetti. I serve it with a mushroom meat sauce that is truly memorable!

My guests insist that Julia Childs had come in to cook for me!

AM I SELFISH?

My friends (and my wife) have accused me of being selfish. I admit to being somewhat of a miser when it came to sharing my mushroom crop. It seems every time I gave my friends a super-size Shiitake, they would come back and pester me for more. I finally had to ask Dr. Mee for additional mushroom logs to save my sanity and several valued friendships.

Dr. Mee is now producing a limited number of Shiitake Mushroom Log kits. We at the Lovin' Spoonful are fortunate in being chosen to introduce it to the general public. As a measure of our enthusiasm and our confidence we offer it to you at our risk. If the Shiitake is not every bit as delicious as we claim, or for any reason, you are not satisfied with the production of the log, return it for a full refund of purchase price. The cost is only $19.95, complete with everything you need to grow a bumper crop. We also include a selection of fabulous mushroom recipes. I guarantee it will be the most delicious investment you will have ever made.

To order use our coupon. Even better, use your credit card and our handy toll free "800" number. Remember you are under no obligation. Order today!

ORDER TOLL-FREE
Call 800-228-2606 Operator 149
In Nebraska Call 800-642-8777
Our telephone lines are open
24 hours a day, 7 days a week

The Lovin' Spoonful™ **Dept. 149**
28 Durham Dr.
Dix Hills, NY 11746

Okay, Hal, tasting is believing! Please send _______ Shiitake Mushroom Log(s) @ $19.95, plus $2.00 postage and handling. I understand that I am under no obligation and if for any reason I am not satisfied with my Shiitake Mushroom Log I can return it within 60 days for a full refund of purchase price.

USE YOUR CREDIT CARD

☐ American Express ☐ Diners Club ☐ Visa

Master Charge Exp. Date _______

Charge # _______________

Signature _______________

(Please Print):

NAME _______________

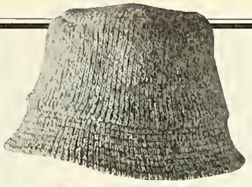
ADDRESS _______________

CITY _______________

STATE _______ ZIP _______

N.Y. residents add sales tax

©The Durham Group, Inc. 1980



RAGG KNIT SLOUCH HAT

Our Ragg Knit version of the classic "bucket-crown" Irish field hat. Knit from 85% lanolin-rich wool for warmth and water repellency, 15% nylon for strength. Folds for stuffing in pocket or pack. One size. Color: Salt & Pepper. $13.95 ppd.

Order Today! Money Back Guarantee!

Here is my check or money order for $ ________
(Add sales tax for shipment into CA, CO, D.C., IL, MA, MI, MN, PA, WA.)
☐ MC ☐ VISA ☐ AMEX
Card no. ________________ Exp. Date______
Please RUSH my #1996 Ragg Knit Slouch Hat.
Name ________________
Address ________________
City ________________
State ____________ Zip ____________

☐ **Send me your FREE outdoor catalog.**

Stores throughout the United States

Eddie Bauer®

Dept. WNH, Fifth & Union, Seattle, WA 98124

We repeat the enormously popular and unusually interesting outdoors programs to the Andes and the Himalayas where our small groups are expertly led by capable mountaineers:

Inca Trek in Peru

JULY 17 TO AUGUST 1, 1982
AUGUST 7 TO 22, 1982

These expeditions provide the stirring experience of walking along the ancient Inca trail from Cuzco high above the lovely Urubamba Valley, at a leisurely pace over three passes and through fabulous Andean scenery to Machu Picchu, the most dramatically spectacular archaeological site in the world. Before and after the trek, first class hotel accommodations are provided in Lima and Cuzco.

Himalayan Trek in Nepal

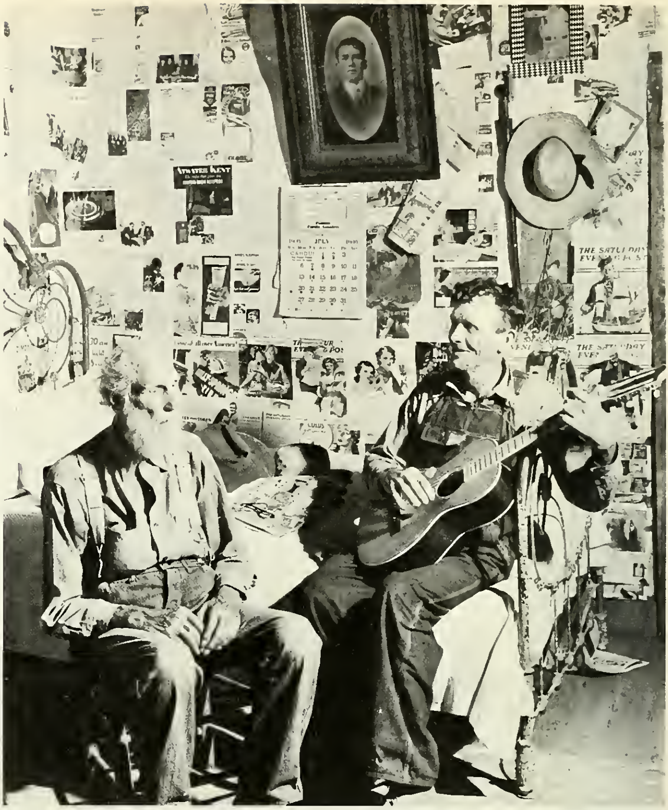
NOVEMBER 20 TO DECEMBER 15, 1982
FEBRUARY 5 TO MARCH 2, 1983

These expeditions are unique not only due to the expert leadership but because they combine a trek on foot in the Annapurna region with a trek on elephant back through the Terai jungle, and a canoe trip on the Rapti River. Between the treks, first class hotel accommodations are provided; and the expedition ends with five days in Northern India, visiting Delhi, Agra and Jaipur.

Please send for detailed brochures of these treks — we also specialize in cruises in the Galapagos Islands, wildlife safaris to see polar bears and seals in northern Canada and to Scotland, Rajasthan and Western Australia, and archaeological tours to Peru, Morocco and Egypt.

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

Margaret Bourke-White, Life Magazine, © Time, Inc.



Colorful and durable, magazine pages were chosen for this Arkansas home.

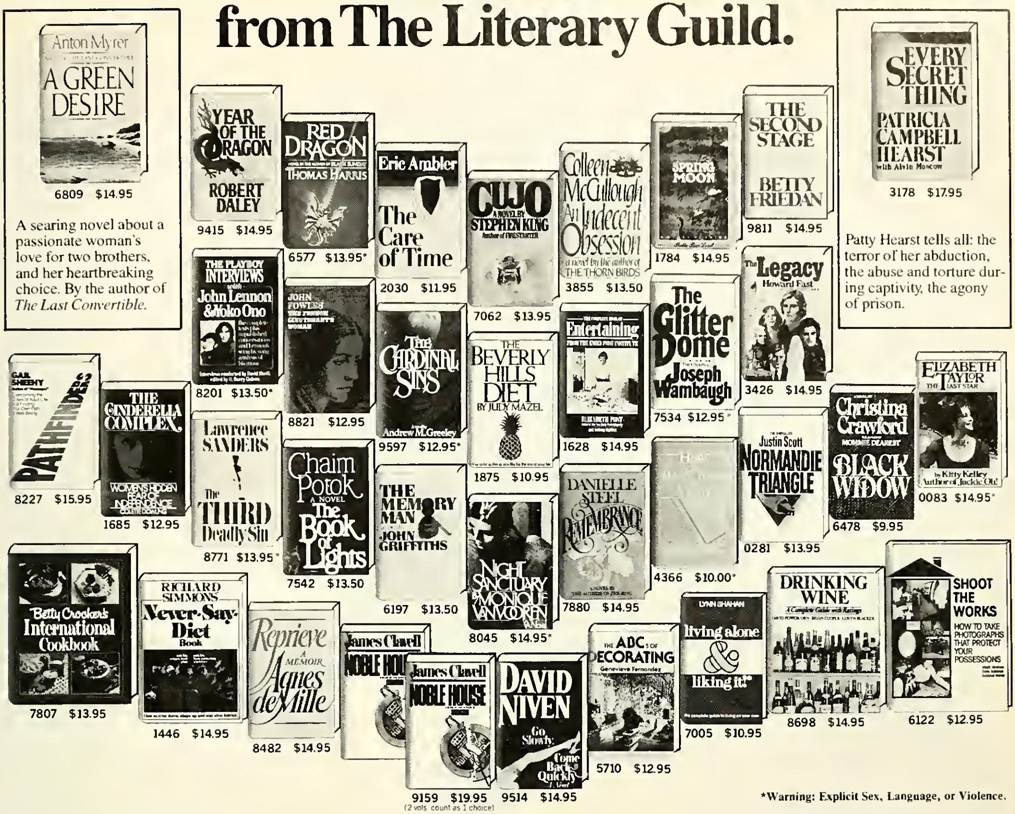
proximated the still lifes that hung on the walls in homes outside the area. Another used Norman Rockwell covers from the *Saturday Evening Post* because they "kind of told a little story," which her small children, who had not yet learned how to read, could appreciate.

Since the walls were repapered at least once a year, the paperer had the opportunity to find new images that reinforced the same theme or to change themes entirely and thus show a different facet of her personality—sometimes at risk. A woman who put a picture of a car in the middle of her wall recalls that "my sisters laughed at me, made a joke about it because I kept this car in my bedroom on the wall. I don't know why I did it unless it was just bright and colorful." (On another occasion, she told me that she used cars because they represented the means to get to all the places, particularly the cities, she wanted to see.)

With magazines, as well as catalogs, there was some segregation by subject matter. Pictures of food were pasted on the walls where the family ate, and recipes went near the stove. Some people arranged the magazine pages across from where they slept, not necessarily by subject matter, but by color, so that as they fell asleep at night the light of the coal fire would reflect off the glossy colored walls, causing those specially chosen hues to dance.

The third type of paper used on a large scale came from the Sears and Montgomery Ward catalogs, called wish books. Some people pasted up the pages in the order they came from the catalog, but others objected to mixing such things as tools and clothes. They felt it was important to keep closely related subjects together and to group the images according to room use: for

From fact to fiction, you get more enjoyment from The Literary Guild.


Anton Myrer
A GREEN DESIRE
YEAR OF THE DRAGON
ROBERT DALEY
RED DRAGON
THOMAS HARRIS
Eric Ambler
The Care of Time
CUJO
A NOVEL BY STEPHEN KING
Colleen McCullough
An Indecent Obsession
a novel by the author of THE THORN BIRDS
SPRING MOON
THE SECOND STAGE
BETTY FRIEDAN
EVERY SECRET THING
PATRICIA CAMPBELL HEARST
with Alvin Moscow
THE PLAYBOY INTERVIEWS with John Lennon & Yoko Ono
JOHN FOWLES
THE CARDINAL SINS
Andrew M. Greeley
THE BEVERLY HILLS DIET
BY JUDY MAZEL
Entertaining
ELIZABETH POST
The Glitter Dome
Joseph Wambaugh
The Legacy
Howard Fast
GAIL SHEEHY
PATHFINDERS
THE CINDERELLA COMPLEX
WOMEN'S HIDDEN FEAR OF INDEPENDENCE
COLETTE DOWLING
Lawrence Sanders
The Third Deadly Sin
Chaim Potok
A NOVEL
The Book of Lights
THE MEMORY MAN
JOHN GRIFFITHS
NIGHT SANCTUARY
MONIQUE VAN VOOREN
DANIELLE STEEL
REMEMBRANCE
Justin Scott
NORMANDIE TRIANGLE
Christina Crawford
BLACK WIDOW
ELIZABETH TAYLOR
THE LAST STAR
by Kitty Kelley
Author of Jackie Oh!
Betty Crocker's International Cookbook
RICHARD SIMMONS
Never-Say-Diet Book
Reprieve
A MEMOIR
Agnes de Mille
James Clavell
NOBLE HOUSE
DAVID NIVEN
Go Slowly, Come Back Quickly
THE ABCs OF DECORATING
Genevieve Fernandez
LYNN SHAHAN
living alone & liking it!
DRINKING WINE
SHOOT THE WORKS
HOW TO TAKE PHOTOGRAPHS THAT PROTECT YOUR POSSESSIONS

6809 $14.95

A searing novel about a passionate woman's love for two brothers, and her heartbreaking choice. By the author of *The Last Convertible*.

9415 $14.95

6577 $13.95*

2030 $11.95

7062 $13.95

3855 $13.50

1784 $14.95

9811 $14.95

3178 $17.95

Patty Hearst tells all: the terror of her abduction, the abuse and torture during captivity, the agony of prison.

8201 $13.50*

8821 $12.95

9597 $12.95*

1875 $10.95

1628 $14.95

7534 $12.95*

3426 $14.95

8227 $15.95

1685 $12.95

8771 $13.95*

7542 $13.50

6197 $13.50

8045 $14.95*

7880 $14.95

4366 $10.00*

0281 $13.95

6478 $9.95

0083 $14.95*

7807 $13.95

1446 $14.95

8482 $14.95

9159 $19.95
(2 vols. count as 1 choice)

9514 $14.95

5710 $12.95

7005 $10.95

8698 $14.95

6122 $12.95

*Warning: Explicit Sex, Language, or Violence.

Any 4 for $1 with membership in The Literary Guild.

Here's how The Literary Guild works:

You choose from a wide range of top best sellers. After your membership's accepted, you get your 4 books or sets for only $1, plus shipping and handling. If you are not completely satisfied, return them within 10 days and we will cancel your membership and you owe nothing.

You never have to buy a minimum number of books a year. Only buy 4 more during your membership, after which you may cancel any time. About every 4 weeks (14 times a year), you'll be offered one or two main selections along with over 100 exciting alternates through your free copy of The Literary Guild Magazine. In addition, up to 4 times a year, you may receive offers of special selections, always at discounts off publishers' prices. If you want the selection(s) featured in the magazine, or the special selection(s), do nothing, they will be shipped to you automatically. If you want an alternate, or no book, return the order form marked with your preference by the date specified. You always have at least 10 days to make a decision. If you get an unwanted selection because you had less than 10 days to make a decision, return it at our expense. There is a shipping and handling charge on all books shipped. The Guild offers its own complete, hardbound editions, sometimes altered in size to fit special presses and save members even more.

With the purchase of every selection and alternate, you receive credits toward bonus books. Use them to acquire valuable books at substantial savings…coffee table volumes, reference works, children's stories, cookbooks, garden guides, and even classics.

FREE TOTE with membership.

The Literary Guild

Dept. DR 264, Garden City, N.Y. 11530

Please accept my application for membership in The Literary Guild and send me the 4 books or sets whose numbers I have printed in the boxes below. Bill me only $1, plus shipping and handling. Also, send my FREE tote bag, which is mine to keep, even if I don't remain a member.

I agree to the membership plan as described in this ad and understand that I need only buy 4 more books, at regular low Club prices, whenever I want them.

NOTE: All prices quoted are for publishers' editions. First number listed below each book or set is the order number.

Mr.
Ms.
Mrs. ____________________
Miss (Please Print)

Address ____________________ Apt. ______

City ____________________

State ____________________ Zip ______

Members accepted in U.S.A. and Canada only. Canadian members will be serviced from Canada. Offer slightly different in Canada. 08-G576

VACATION...PLANET EARTH

Explore the Earth with Nature Expeditions International on extraordinary wildlife, cultural and wilderness journeys of discovery.

Travel on foot, camel, elephant and yak . . . Observe exotic cultures, tribes and ruins . . . Photograph birds, flowers, whales, lions and mountains.

Stimulate your mind, body and spirit on one of 30 exciting adventure vacations conducted on six continents.

For free brochures and itineraries, write
Nature Expeditions International
599 College Avenue, Dept. N
Palo Alto, CA 94306•(415) 494-6572

Beautiful Lingerie!

A luxurious catalogue of lacy teddies, camisoles & tap pants, French bra & bikini sets, fashionable garter belts & hosiery, elegant gowns, kimonos. . . & much more.

Victoria's Secret
designer lingerie

Send $3 for catalogue to NH-02
Box 31442, San Francisco CA 94131
Boutiques in San Francisco, Palo Alto & Cupertino, CA

SEMINARS IN ORNITHOLOGY

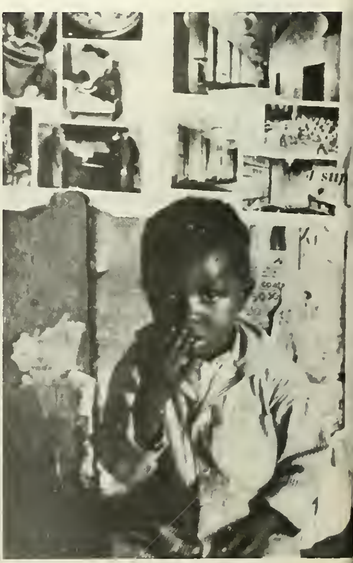
The Laboratory of Ornithology
at Cornell University
Offers a Home Study Course
in Bird Biology

Inquire: HN, 159 Sapsucker Woods Road,
Ithaca, NY 14850

example, toys for boys went where the boys slept, girls' dresses and furniture were placed in the girls' area, and dresses and shoes usually went in the adults' bedroom. As the paper went up, family members were allowed to choose the subjects that, until the next papering, would define the limits of their individual living space. The communal living areas, on the other hand, were generally decorated at the discretion of the paperer.

Paper flour sacks were also used on the walls, but for a different effect. Flour sacks sold in Appalachia before World War II were white on the outside and covered with print, but the inside was a robin's-egg blue. Women were careful to open the sack by the folds, without tearing it. When the sack was empty, it was unfolded, laid flat, and saved until enough sacks had accumulated to cover a wall. Then all the frayed ends were trimmed with scissors and the paper applied in the usual way. Some paperers took red paper from other kinds of sacks and outlined the blue walls with it, sometimes making a scalloped border.

Newspaper had yet another decorative use: instead of pasting scalloped pieces on the walls, paperers often hung them from the mantel, from the cupboards, along the window sills, and from the ceiling joists if these were visible. These cutouts, called lacing, were considered pretty in themselves, but they also trembled in the breeze—a visual treat usually reserved for springtime,



when the doors were left open on warm, windy days.

There were other decorations used to herald spring. After the weather warmed enough so that coal was no longer burned, the firebox was cleaned of its soot and ashes and the grate taken out and scrubbed down to the metal. Orange clay was then rubbed over the front of the grate before setting it back in the firebox. The fireplace arch and jamb rocks were coated with white or blue clay, and willows or garden roses were cut, placed in the grate, and allowed to extend a short distance into the room.

Spring-cleaning was a form of decoration. One woman recalls:

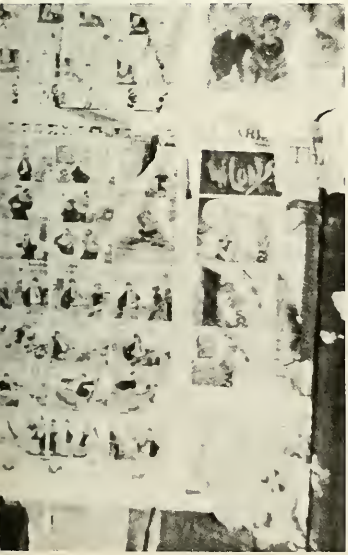
> That good fresh smell of clay. There were clay banks, really, and you'd go and get that, and it was already gooey, you know, and it was just white as it could be, and when it would dry, it was as white as snow. A lot of people that didn't want to paper but they had the ceiling, the rough ceiling, and they would put that over the ceiling. It was just like paint, it was beautiful. And when we scrubbed our floors—we didn't have rugs of any kind—and when we scrubbed our floors, we beat up the whitest sand rocks. That was a day's work for the children, to take a hammer and beat up all that sand, if you were going to scrub the next day. After we had rinsed it all off—scrub it and rinse it all off—then we would sprinkle that sand over it and let it lay on there until it dried, then sweep it off and it was just as white and smelled so good and fresh.

A well-scrubbed poplar floor was said to look as if it had a coat of wax (and it also kept down the spring fleas). Some people scrubbed not only the floor but also the door and window facings and even the chairs.

What is left of all this work done years ago in Appalachia is the image of a room freshly papered, with edges perfectly straight, the floors and doors white, the green of spring extending out from the once-black heat source, and the lacing moving sporadically in the breeze that made its way through the opened doors and windows. One obvious value of these decorations was their thrift. Another was cleanliness: if one walked into a house, however humble, and clean paper was on the walls, the housekeeper was automatically assumed to be a good one. And each family member could attach his or her own interpretation to the images scattered about the walls, viewing them as artistic, educational, entertaining, or symbolic of personal dreams.

In addition, these images of houses,

Papered walls, as in this Louisiana home, could amuse or teach children.



Margaret Bourke-White, Life Magazine, © Time, Inc.

High yields? Yes.
Easy access? Yes.
Free checks? Yes.
And no penalties!

Start with just $2,500. You can add to your account at any time with investments as low as $100. And you're not locked into any time period. Your money is always available whenever you need it, with no penalty for withdrawal. For full details on this popular money market fund, mail coupon or call today.

Dreyfus Liquid Assets

For more complete information, including management fee charges and expenses, obtain a prospectus by sending this coupon. Read it carefully before you invest or send money.

Name__________

Address__________

City__________

State__________ Zip__________

0488 2260111

Post Office Box 600
Middlesex, NJ 08846

FOR A PROSPECTUS
Call toll free, day or night, 7 days a week
1-800-345-8501
Extension 845
In Pennsylvania
1-800-662-5180
Extension 845

Of course, in a bank your principal is insured and does not fluctuate, but your investment has a fixed return.

cars, clothes, Christmas, and carefully arranged foods increasingly influenced the people of the region to change their idea of what life was supposed to be like. Beginning in about 1900, the coal industry expanded rapidly, and the coal-related paycheck began to replace agricultural barter. By the 1930s rural eastern Kentucky was feeling the full effects of consumerism, and the papered walls presented a society, not of traditional farmers, but of suburban men, in polished work boots and pressed work clothes, who carried undented lunch boxes to clean factories, whose wives had well-equipped white kitchens, and whose children had every kind of toy. The pictures of factory-made furniture, automobile seat covers, and electric refrigerators beckoned to people in eastern Kentucky as examples of the wonders and conveniences of the industrial world. Low wages perhaps prevented their purchasing these wonders, but the subtle media messages were not lost on them.

When family members divided catalogs by subjects to define individual space or gave a particular image prominence in the center of a carefully ordered wall, they took a calculated step away from predictability based on tradition and toward symbols conceived by national advertisers. It was a prelude to their decision to pursue, not a community-oriented agricultural system of survival, in which neighbors helped each other build, plant, and harvest, but a more economically complex industrial system, in which mobility promised to spiral steadily upward and choices would be made on a personal, not a group, basis. Walls papered with printed matter were a part of the conscious acceptance of change, born of the Appalachians' optimistic expectation that they would use industry rather than let it use them.

How do contemporary residents of Appalachia look back upon these former decorating techniques? That depends on how old they are. Younger people, those born since 1950, are emotionally and experientially removed from papered walls and equate them with the bad old days of technological deprivation. They would not, under any foreseeable circumstances, decorate that way. ("Are you crazy?" was one young woman's response to me.)

Older people, who had actually papered walls and understood the aesthetic, functional, and symbolic value of the practice, are still drawn to it. Several of the people I interviewed expressed the desire to again someday paper a wall with newspaper. But which wall? Well, it would have to be a wall tucked away out of sight because, as one woman put it, "People would make fun of me." She and many other women are afraid of embarrassing their children and grandchildren, who view Appalachia's past so differently. Many feel they would paper in the old, emotionally comforting way if it were not for the pressure put upon them by young people not to. One woman sums up how taste and values have changed in Appalachia when she says,

> You could cut newspaper out in all kind of little designs, you know. Fold it together and cut it out. Oh, you just learn a lot of things, when you have to make your own. But now, you know, it wouldn't go good now, but it was really pretty then. And everybody lived alike, you know, that was the thing about it. Nobody, even if somebody had a little more money, they didn't show it. And now everybody wants to live just a little bit more than somebody else.

Charles E. Martin is an assistant professor of history and anthropology at Alice Lloyd College in Pippa Passes, Kentucky.

Scenes as never before
QUALITY SPOTTING SCOPES
from
SWIFT®

with telephoto capability up to 4000mm

Get in the middle of the action from 1000 yards away... your Swift 841 Telemaster Mark II gives you telephoto capability up to 4000mm focal length. Fingertip controls, for the 14-lens optical system, facilitate crisp focus and infinitely variable magnification from 15X to 60X. 60mm objective ensures bright to brilliant image.

Swift also makes the 844 Commando 20X, 60 Mark II and the 847 Scanner 25X, 50 — all are high quality prismatic spotting scopes and telephoto lenses. To put the world at your fingertips... to capture scenes as never before... Swift Quality Spotting Scopes. Just aim, focus, and zoom.

For More Information: SWIFT INSTRUMENTS, INC., 952 Dorchester Ave., Boston, MA 02125 or P.O. Box 562, San Jose, CA 95106

The 1982 NATURAL HISTORY Photographic Competition Is Open for Entries

The Grand Prize for the 1982 Natural History Photographic Competition will be an eleven-day trip to the Galápagos Islands, the volcanic archipelago that lies in the Pacific Ocean 600 miles off the coast of Ecuador. The prize, worth more than $2,500, includes airfare from New York, a stay in highland Ecuador, and a berth on the yacht *Buccaneer*. A living laboratory for the study of natural history, the Galápagos Islands are renowned for the influence they had on Charles Darwin and the development of evolutionary theory. The islands' exotic birds and reptiles—many unique to the area—are remarkably tame; our Grand Prize-winner can look forward to a rare opportunity to record wildlife at close range. Three Museum scientists will introduce the biological and geological features encountered during this American Museum of Natural History Discovery Tour.

First Prizes of $500 each will be awarded in the contest's five categories: Animals (including birds and bugs); Plants and Their Environment; The Human Family; A Sequence in Nature (up to five photographs); and Humor in Nature. Ten Honorable Mentions of $100 will be selected from all entries.

In addition, the designer and the editor of *Natural History* will choose a special $500 Cover Photograph Award for the July 1982 issue. Strong design, wide appeal, vertical format, and space for the magazine's logo will be among the points considered for this award.

The winning entries will be published in the July issue of *Natural History* and exhibited at the American Museum of Natural History. All winners will receive certificates of their awards, suitable for framing.

The 1982 *Natural History*
Photographic Competition
—Official Entry—

Name ____________________
Address ____________________
____
____
Phone ( ) ____________________

For office use

Logged in:
____
date initials

Returned:
____
date initials

List all photographs entered, including each item in a sequence:
number: ______transparencies
number: ______prints
total: ______

THE RULES

1. The competition is open to everyone except employees of the American Museum and their kin.
2. You may submit a total of up to five entries, in any combination of the categories (a sequence is considered a single entry). The photographs must have been taken by you and not have been published before.
3. The Museum acquires the right to publish, exhibit, and use for promotion the winning photographs. The Museum assumes no responsibility for entries.
4. Entries may be transparencies or prints, either color or black-and-white, up to 8 by 10 inches. Each must bear the photographer's name and address. Entries must *not* be mounted in glass.
5. Please enclose the official entry form (or a 3- by 5-inch facsimile), with your name, address, phone number, and total number of photographs submitted.
6. A self-addressed, stamped envelope must accompany your entries for them to be returned.
7. Entries must be postmarked no later than April 1, 1982.

Pack them carefully and mail them to:
Natural History Photographic Competition
11 West 77th Street
New York, New York 10024

And good luck!

DISCOVER A CRADLE OF CIVILIZATION. IN THE LAP OF LUXURY.

At last, you can explore the magnificent destinations of China and the Far East without sacrificing magnificent accommodations.

Introducing the "Pearl of Scandinavia."

Starting in May, 1982, you can sail aboard this remarkable new Cruiseliner, and discover the legendary civilizations of China, Indonesia, the Philippines, Malaysia and Japan.

Then, when each shore adventure is behind you, you'll return to a ship that's as comfortable as home. Yet as elegant as a European resort.

The "Pearl of Scandinavia" is the only Cruiseliner to explore Asia every two weeks, all year round. You can join us for as little as 14 days. Or as long as 42. Concentrate on one area of exploration. Or see it all!

Just ask your Travel Agent for our brochure or send us this coupon.

And we'll show you all the wonders of Asia. Scandinavian Style.

PEARL OF SCANDINAVIA

PEARL CRUISES OF SCANDINAVIA NHB
1045 Sansome Street, San Francisco, CA 94111
(415) 391-7941 (800) 792-0944 in California,
(800) 227-5666 Continental U.S.A.

Send me your full cruise brochure, deck plans and fares.

NAME

ADDRESS

CITY/STATE/ZIP

MY TRAVEL AGENCY

Registry: Bahamas

Pearl Cruises
of Scandinavia

Nonmoral Nature

"The whole subject," wrote Darwin, "is too profound for the human intellect"

by Stephen Jay Gould

When the Right Honorable and Reverend Francis Henry, earl of Bridgewater, died in February, 1829, he left £8,000 to support a series of books "on the power, wisdom and goodness of God, as manifested in the creation." William Buckland, England's first official academic geologist and later dean of Westminster, was invited to compose one of the nine Bridgewater Treatises. In it he discussed the most pressing problem of natural theology: if God is benevolent and the Creation displays his "power, wisdom and goodness," then why are we surrounded with pain, suffering, and apparently senseless cruelty in the animal world?

Buckland considered the depredation of "carnivorous races" as the primary challenge to an idealized world in which the lion might dwell with the lamb. He resolved the issue to his satisfaction by arguing that carnivores actually increase "the aggregate of animal enjoyment" and "diminish that of pain." The death of victims, after all, is swift and relatively painless, victims are spared the ravages of decrepitude and senility, and populations do not outrun their food supply to the greater sorrow of all. God knew what he was doing when he made lions. Buckland concluded in hardly concealed rapture:

> The appointment of death by the agency of carnivora, as the ordinary termination of animal existence, appears therefore in its main results to be a dispensation of benevolence; it deducts much from the aggregate amount of the pain of universal death; it abridges, and almost annihilates, throughout the brute creation, the misery of disease, and accidental injuries, and lingering decay; and imposes such salutary restraint upon excessive increase of numbers, that the supply of food maintains perpetually a due ratio to the demand. The result is, that the surface of the land and depths of the waters are ever crowded with myriads of animated beings, the pleasures of whose life are coextensive with its duration; and which throughout the little day of existence that is allotted to them, fulfill with joy the functions for which they were created.

We may find a certain amusing charm in Buckland's vision today, but such arguments did begin to address "the problem of evil" for many of Buckland's contemporaries—how could a benevolent God create such a world of carnage and bloodshed? Yet these claims could not abolish the problem of evil entirely, for nature includes many phenomena far more horrible in our eyes than simple predation. I suspect that nothing evokes greater disgust in most of us than slow destruction of a host by an internal parasite—slow ingestion, bit by bit, from the inside. In no other way can I explain why *Alien*, an uninspired, grade-C, formula horror film, should have won such a following. That single scene of Mr. Alien, popping forth as a baby parasite from the body of a human host, was both sickening and stunning. Our nineteenth-century forebears maintained similar feelings. Their greatest challenge to the concept of a benevolent deity was not simple predation—for one can admire quick and efficient butcheries, especially since we strive to construct them ourselves—but slow death by parasitic ingestion. The classic case, treated at length by all the great naturalists, involved the so-called ichneumon fly. Buckland had sidestepped the major issue.

The ichneumon fly, which provoked such concern among natural theologians, was a composite creature representing the habits of an enormous tribe. The Ichneumonoidea are a group of wasps, not flies, that include more species than all the vertebrates combined (wasps, with ants and bees, constitute the order Hymenoptera; flies, with their two wings—wasps have four—form the order Diptera). In addition, many related wasps of similar habits were often cited for the same grisly details. Thus, the famous story did not merely implicate a single aberrant species (perhaps a perverse leakage from Satan's realm), but perhaps hundreds of thousands of them—a large chunk of what could only be God's creation.

The ichneumons, like most wasps, generally live freely as adults but pass their larval life as parasites feeding on the bodies of other animals, almost invariably members of their own phylum, Arthropoda. The most common victims are caterpillars (butterfly and moth larvae), but some ichneumons prefer aphids and others attack spiders. Most hosts are parasitized as larvae, but some adults are attacked, and many tiny ichneumons inject their brood directly into the egg of their host.

The free-flying females locate an appropriate host and then convert it to a food factory for their own young. Parasitologists speak of ectoparasitism when the uninvited guest lives on the surface of its host, and endoparasitism when the parasite dwells within. Among endoparasitic ichneumons, adult females pierce the host with their ovipositor and deposit eggs within it. (The ovipositor, a thin tube extending backward from the wasp's rear end, may be many times as long as the body itself.) Usually, the host is not otherwise inconvenienced for the moment, at least until the eggs hatch and the ichneumon larvae begin their grim work of interior excavation.

Chinese delicacy.

Carefully formed layer upon layer of Chinese cinnabar lacquer and featuring delicately carved Oriental characters and flowers, the unique egg includes rosewood stand. 4" tall. From China. $33.50 (includes postage). Satisfaction guaranteed.

Send me ______ Chinese cinnabar egg(s) @ $33.50 each. 5R0104

Name ______

Address ______

City ______ State ______ Zip ______

☐ Cheque or money order enclosed.

☐ VISA ☐ MasterCard ☐ American Express

Exp. date ______

Signature ______

☐ YES! Please send me a complete catalogue of international treasures, free with my order. ($1.00 separately.)

Willoughby & Taylor Ltd.
International Merchants
2912 Iron Ridge Road, Dallas, Texas 75247

For charge orders, call Toll-Free (800) 527-1885.
In Texas, call collect (214) 634-4500.

CRUISE TO THE WORLD'S HIDDEN CORNERS.

Join discerning travelers on an unforgettable WORLD DISCOVERER Voyage.

The Amazon · Antarctica · New Guinea · Indonesia · Singapore/Burma/India/ Sri Lanka/Seychelles · Arabia · Iceland/Greenland · North & West Africa

14 to 76 Days. From $2,920 to $32,000.

Society Expeditions

Dept. NH2 723 Broadway East, Seattle, WA 98102

I'd like to explore the remote cruising opportunities of Society Expeditions, detailed in your 36 page cruise catalog.

NAME ______

STREET ______

CITY/STATE/ZIP ______

PHONE ( )

YOUR TRAVEL AGENT ______

The MS *WORLD DISCOVERER* is registered in Singapore

Among ectoparasites, however, many females lay their eggs directly upon the host's body. Since an active host would easily dislodge the egg, the ichneumon mother often simultaneously injects a toxin that paralyzes the caterpillar or other victim. The paralysis may be permanent, and the caterpillar lies, alive but immobile, with the agent of its future destruction secure on its belly. The egg hatches, the helpless caterpillar twitches, the wasp larva pierces and begins its grisly feast.

Since a dead and decaying caterpillar will do the wasp larva no good, it eats in a pattern that cannot help but recall, in our inappropriate, anthropocentric interpretation, the ancient English penalty for treason—drawing and quartering, with its explicit object of extracting as much torment as possible by keeping the victim alive and sentient. As the king's executioner drew out and burned his client's entrails, so does the ichneumon larva eat fat bodies and digestive organs first, keeping the caterpillar alive by preserving intact the essential heart and central nervous system. Finally, the larva completes its work and kills its victim, leaving behind the caterpillar's empty shell. Is it any wonder that ichneumons, not snakes or lions, stood as the paramount challenge to God's benevolence during the heyday of natural theology?

As I read through the nineteenth- and twentieth-century literature on ichneumons, nothing amused me more than the tension between an intellectual knowledge that wasps should not be described in human terms and a literary or emotional inability to avoid the familiar categories of epic and narrative, pain and destruction, victim and vanquisher. We seem to be caught in the mythic structures of our own cultural sagas, quite unable, even in our basic descriptions, to use any other language than the metaphors of battle and conquest. We cannot render this corner of natural history as anything but story, combining the themes of grim horror and fascination and usually ending not so much with pity for the caterpillar as with admiration for the efficiency of the ichneumon.

I detect two basic themes in most epic descriptions: the struggles of prey and the ruthless efficiency of parasites. Although we acknowledge that we witness little more than automatic instinct or physiological reaction, still we describe the defenses of hosts as though they represented conscious struggles. Thus, aphids kick and caterpillars may wriggle violently as wasps attempt to insert their ovipositors. The pupa of the tortoiseshell butterfly (usually considered an inert creature silently awaiting its conversion from duckling to swan) may contort its abdominal region so sharply that attacking wasps are thrown into the air. The caterpillars of *Hapalia*, when attacked by the wasp *Apanteles machaeralis*, drop suddenly from their leaves and suspend themselves in air by a silken thread. But the wasp may run down the thread and insert its eggs nonetheless. Some hosts can encapsulate the injected egg with blood cells that aggregate and harden, thus suffocating the parasite.

J. H. Fabre, the great nineteenth-century French entomologist, who remains to this day the preeminently literate natural historian of insects, made a special study of parasitic wasps and wrote with an unabashed anthropocentrism about the struggles of paralyzed victims (see his books *Insect Life* and *The Wonders of Instinct*). He describes some imperfectly paralyzed caterpillars that struggle so violently every time a parasite approaches that the wasp larvae must feed with unusual caution. They attach themselves to a silken strand from the roof of their burrow and descend upon a safe and exposed part of the caterpillar:

> The grub is at dinner: head downwards, it is digging into the limp belly of one of the caterpillars. . . . At the least sign of danger in the heap of caterpillars, the larva retreats . . . and climbs back to the ceiling, where the swarming rabble cannot reach it. When peace is restored, it slides down [its silken cord] and returns to table, with its head over the viands and its rear upturned and ready to withdraw in case of need.

In another chapter, he describes the fate of a paralyzed cricket:

> One may see the cricket, bitten to the quick, vainly move its antennae and abdominal styles, open and close its empty jaws, and even move a foot, but the larva is safe and searches its vitals with impunity. What an awful nightmare for the paralyzed cricket!

Fabre even learned to feed some paralyzed victims by placing a syrup of sugar and water on their mouthparts—thus showing that they remained alive, sentient, and (by implication) grateful for any palliation of their inevitable fate. If Jesus, immobile and thirsting on the cross, received only vinegar from his tormentors, Fabre at least could make an ending bittersweet.

The second theme, ruthless efficiency

If You Read Music... You'll Love Our Magazine

The Only Magazine You Can Play!

We call it SHEET MUSIC MAGAZINE. And that's exactly what it is! Each and every issue is filled with the most popular sheet music ever published, including *Pop, Great Standards, Jazz, Show Tunes, Folk, Country, Tin Pan Alley, Movie Songs, Classics, Ragtime, Blues,* and more.

When you sit down at your piano, organ, guitar, or any musicial instrument, *we want to be your music book!* And when you want to improve your own musical ability, we want our staff of writers to *show you how.* And in every issue they do just that! There are Keyboard Clinics, Guitar Workshops, Composers' Workshops, Sight-reading, Playing By Ear, Theory And Harmony, Rhythm Workshops, and so much, much more.

A single year's subscription brings you more than 100 great songs. And when you consider the price of sheet music these days, about $2.50 per song, and realize that Sheet Music Magazine provides the exact same thing for less than *15¢ a song,* you can understand why it has more subscribers than any other music magazine in the world today. A one-year subscription for $13.97 brings you over $250 worth of music!

And now you can choose between a *Piano Editon* and an *Organ Edition.* Each edition is specifically arranged for *your* instrument, and includes feature articles of special interest to *you.* Also, you can choose an *easy-to-play* version of the piano edition as well as the organ edition. The *easy-to-play* editions are especially good for you beginners and new students, young or adult, who don't think you are quite ready for the standard and special arrangements found in our standard editions. (If you are undecided as to which version would be right for you, we suggest you try the *Easy Edition.* You can change at any time, at no cost whatsoever.) Check your preference on the subscription application.

Let us send you your first issue with these wonderful songs . . . *All The Things You Are* . . . *Canadian Sunset* . . . *Hurting Each Other* . . . *I Will Wait For You* . . . *Make Believe* . . . *Smoke Gets In Your Eyes* . . . *They Didn't Believe Me* . . . *Watch What Happens* . . . *Why Do I Love You* . . . *Yesterdays.*

Sheet Music Magazine Dept. L1-34-22, 352 Evelyn Street, Paramus, N.J. 07652

Please enter my subscription to Sheet Music Magazine and rush me my first issue with all the songs listed above. I understand that I may cancel at any time and receive a complete refund on all unmailed issues. No questions asked.

(✓) check one
Piano/Guitar
☐Easy
☐Standard

Organ
☐Easy
☐Standard

(✓) check one
☐One Year (9 issues) $13.97
☐Two Years (18 issues) $25.00

Name ____________________
Address ____________________
City __________ State______ Zip______
☐I enclose full payment of $________(Make check payable to Sheet Music Magazine)
Charge to: ☐Master Charge ☐Visa
Account No. __________ Exp. Date______
Canadian residents please add $2.00 per year extra for postage.

of the parasites, leads to the opposite conclusion—grudging admiration for the victors. We learn of their skill in capturing dangerous hosts often many times larger than themselves. Caterpillars may be easy game, but the psammocharid wasps prefer spiders. They must insert their ovipositors in a safe and precise spot. Some leave a paralyzed spider in its own burrow. *Planiceps hirsutus*, for example, parasitizes a California trapdoor spider. It searches for spider tubes on sand dunes, then digs into nearby sand to disturb the spider's home and drive it out. When the spider emerges, the wasp attacks, paralyzes its victim, drags it back into its own tube, shuts and fastens the trapdoor, and deposits a single egg upon the spider's abdomen. Other psammocharids will drag a heavy spider back to a previously prepared cluster of clay or mud cells. Some amputate a spider's legs to make the passage easier. Others fly back over water, skimming a buoyant spider along the surface.

Some wasps must battle with other parasites over a host's body. *Rhyssella curvipes* can detect the larvae of wood wasps deep within alder wood and drill down to its potential victims with its sharply ridged ovipositor. *Pseudorhyssa alpestris*, a related parasite, cannot drill directly into wood since its slender ovipositor bears only rudimentary cutting ridges. It locates the holes made by *Rhyssella*, inserts its ovipositor, and lays an egg on the host (already conveniently paralyzed by *Rhyssella*), right next to the egg deposited by its relative. The two eggs hatch at about the same time, but the larva of *Pseudorhyssa* has a bigger head bearing much larger mandibles. *Pseudorhyssa* seizes the smaller *Rhyssella* larva, destroys it, and proceeds to feast upon a banquet already well prepared.

Other praises for the efficiency of mothers invoke the themes of early, quick, and often. Many ichneumons don't even wait for their hosts to develop into larvae, but parasitize the egg directly (larval wasps may then either drain the egg itself or enter the developing host larva). Others simply move fast. *Apanteles militaris* can deposit up to seventy-two eggs in a single second. Still others are doggedly persistent. *Aphidius gomezi* females produce up to 1,500 eggs and can parasitize as many as 600 aphids in a single working day. In a bizarre twist upon "often," some wasps indulge in polyembryony, a kind of iterated supertwinning. A single egg divides into cells that aggregate into as many as 500 individuals. Since some polyembryonic wasps parasitize caterpillars much larger than themselves and may lay up to six eggs in each, as many as 3,000 larvae may develop within, and feed upon, a single host. These wasps are endoparasites and do not paralyze their victims. The caterpillars writhe back and forth, not (one suspects) from pain, but merely in response to the commotion induced by thousands of wasp larvae feeding within.

The efficiency of mothers is matched by their larval offspring. I have already mentioned the pattern of eating less essential parts first, thus keeping the host alive and fresh to its final and merciful dispatch. After the larva digests every edible morsel of its victim (if only to prevent later fouling of its abode by decaying tissue), it may still use the outer shell of its host. One aphid parasite cuts a hole in the belly of its victim's shell, glues the skeleton to a leaf by sticky secretions from its salivary gland, and then spins a cocoon to pupate within the aphid's shell.

In using inappropriate anthropocentric language in this romp through the natural history of ichneumons, I have tried to emphasize just why these wasps became a preeminent challenge to natural theology—the antiquated doctrine that attempted to infer God's essence from the products of his creation. I have used twentieth-century examples for the most part, but all themes were known and stressed by the great nineteenth-century natural theologians. How then did they square the habits of these wasps with the goodness of God? How did they extract themselves from this dilemma of their own making?

The strategies were as varied as the practitioners; they shared only the theme of special pleading for an a priori doctrine—they knew that God's benevolence was lurking somewhere behind all these tales of apparent horror. Charles Lyell, for example, in the first edition of his epochal *Principles of Geology* (1830–1833), decided that caterpillars posed such a threat to vegetation that any natural checks upon them could only reflect well upon a creating deity, for caterpillars would destroy human agriculture "did not Providence put causes in operation to keep them in due bounds."

The Reverend William Kirby, rector of Barham and Britain's foremost entomologist, chose to ignore the plight of caterpillars and focused instead upon the virtue of mother love displayed by wasps in provisioning their young with such care.

> The great object of the female is to discover a proper nidus for her eggs. In search of this she is in constant motion. Is the caterpillar of a butterfly or moth the appropriate food for her young? You see her alight upon the plants where they are most usually to be met with, run quickly over them, carefully examining every leaf, and, having found the unfortunate object of her search, insert her sting into its flesh, and there deposit an egg. . . . The active Ichneumon braves every danger, and does not desist until her courage and address have insured subsistence for one of her future progeny.

Kirby found this solicitude all the more remarkable because the female wasp will never see her child and enjoy the pleasures of parenthood. Yet her love compels her to danger nonetheless:

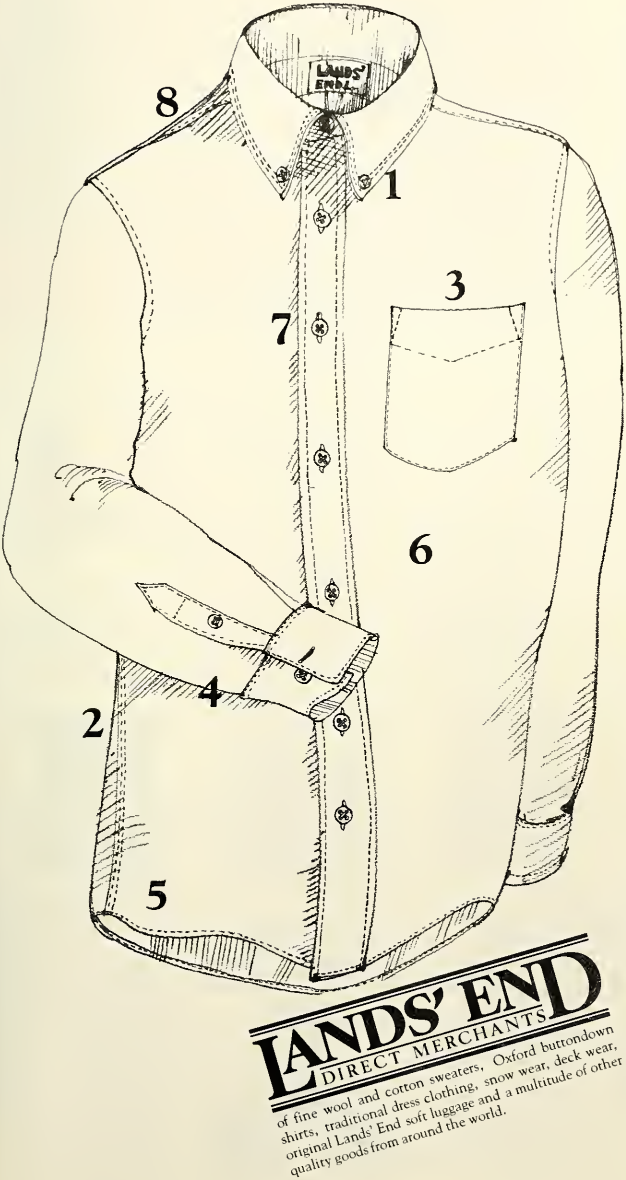
> A very large proportion of them are doomed to die before their young come into existence. But in these the passion is not extinguished. . . . When you witness the solicitude with which they provide for the security and sustenance of their future young, you can scarcely deny to them love for a progeny they are never destined to behold.

Kirby also put in a good word for the marauding larvae, praising them for their forbearance in eating selectively to keep their caterpillar prey alive. Would we all husband our resources with such care!

> In this strange and apparently cruel operation one circumstance is truly remarkable. The larva of the Ichneumon, though every day, perhaps for months, it gnaws the inside of the caterpillar, and though at last it has devoured almost every part of it except the skin and intestines, carefully all this time it avoids injuring the vital organs, as if aware that its own existence depends on that of the insect upon which it preys! . . . What would be the impression which a similar instance amongst the race of quadrupeds would make upon us? If, for example, an animal . . . should be found to feed upon the inside of a dog, devouring only those parts not essential to life, while it cautiously left uninjured the heart, arteries, lungs, and intestines,—should we not regard such an instance as a perfect prodigy, as an example of instinctive forbearance almost miraculous? [The last three quotes come from the 1856, and last pre-Darwinian, edition of Kirby and Spence's *Introduction to Entomology*.]

This tradition of attempting to read moral meaning from nature did not cease with the triumph of evolutionary theory after Darwin published *On the Origin of Species* in 1859—for evolution could be read as God's chosen method of peopling our planet, and ethi-

We set out to make the world's best buttondown. This one comes close. At $22.



This is the Hyde Park—the latest addition to our impressive Oxford Collection, featuring both shirts of 100% cotton and our Lands' End reverse cotton blends.

Check it out feature for feature, beginning with the knowledge that it's made of imported 100% cotton Oxford. Heavier. More densely woven for a nicer drape. It launders better, resists wrinkles; best of all, it wears longer than normal.

For those of you interested in more specifics, we've provided this step-by-step "tour" of the shirt—available in pink, ecru, blue, maize, and white in our Spring catalog:

1. **Double-track stitching highlights the softly-rolled collar, keeps it neater with a tie.**
2. **The shirt is single-needle stitched, with strong double-needle side seams.**
3. **Note the placement and detailing of the left breast pocket.**
4. **Barrel cuffs have a long, buttoned placket.**
5. **The shirt has extra long tails, so it stays neatly tucked in.**
6. **The cut is full, for comfort. Yet civilized, too. Tapered just enough to avoid being sloppy.**
7. **Note that it has a generous 7-button front.**
8. **In back, a box pleat with hanging loop adds function and style.**

Why make so much of a single shirt? We may have told you more than you ever wanted to know about a shirt. But only to make a point about the Lands' End philosophy of doing business. It is a simple philosophy really:

First, *quality.* Then, *price.* And always, always *service.*

A quality item at a reasonable price represents a Lands' End value. Anything less is someone else's ballgame—not ours. What's more, every item we offer you—from soft luggage to sweaters to snow wear to shoes—is unconditionally guaranteed.

We don't ask you to trust us, just try us. Mail the coupon for a free catalog. Better still call our toll-free 800 number, 800-356-4444. 24 hours a day. Except in Wisconsin, 608-935-2788.

LANDS' END
DIRECT MERCHANTS

of fine wool and cotton sweaters, Oxford buttondown shirts, traditional dress clothing, snow wear, deck wear, original Lands' End soft luggage and a multitude of other quality goods from around the world.

☐ **Please send free 76-page catalog.**
Lands' End Dept. P-08 Dodgeville, WI 53533

Name ________________

Address ________________

City ________________

State ________ Zip ________

Or call Toll-free
800-356-4444
(Except Wisconsin call 608-935-2788).

NOW ALL THE BEST BOOKS ABOUT

Q: Is this the only universe?

A: Reasoning from quantum theory, some scientists now believe there may be other universes in addition to our own—perhaps an infinite number of them! All of the universes, including ours, would be embedded in a mind-boggling entity called "superspace."
(See *Other Worlds*)

Q: What common creature is a direct descendant of the dinosaurs?

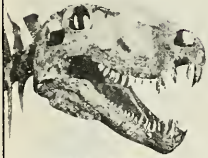
A: There may be one perched on your windowsill right now—the *bird*. Not only are birds direct descendants of the dinosaurs, but some biologists think they're even eligible for the title "living dinosaurs." (See *Extinction*)

Q: What fish goes fishing complete with line and bait?

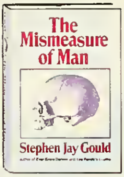
A: It's called an anglerfish. It looks like a rock, and thus camouflages itself on the ocean bottom. Coming out of its mouth is a thin, wiggly structure that resembles a piece of string. At the end of the "string" is another structure that looks exactly like a tiny fish—an exquisitely accurate fake complete with eye-like spots of pigment, fins and tail. When an unsuspecting fish tries to snare the decoy, the anglerfish makes a quick meal of the visitor.
(See *The Panda's Thumb*)

DAVID ATTENBOROUGH
Life on Earth

199 Life on Earth:
A Natural History.
David Attenborough
(Pub price $22.50)



119 Until the Sun Dies
Robert Jastrow. A clear explanation of current scientific thought on the creation of the universe and the origins of life.
(Pub price $8.95)

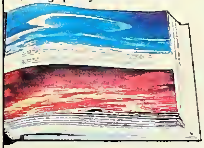


196 The Mismeasure of Man
Stephen Jay Gould
(Pub price $14.95)

124 The Origin of Consciousness in the Breakdown of the Bicameral Mind
Julian Jaynes
(Pub price $12.95)

180 Genesis: The Origins of Man and the Universe.
John Gribbin. A time trip from the universe's birth to its probable end, showing mankind's place within it.
(Pub price $13.95)

Photographs by Vincent J. Schaefer



161 A Field Guide to the Atmosphere. Vincent J. Schaefer and John A. Day
(Pub price $13.95)

130 Sand Rivers. Peter Matthiessen. Photographs by Hugo van Lawick. A visit to Africa's largest and least accessible wildlife sanctuary with the author of *The Tree Where Man Was Born*.
(Pub price $19.95)

179 Drawing on the Right Side of the Brain: A Course in Enhancing Creativity and Artistic Confidence.
Betty Edwards. *(Softcover)*
(Pub price $8.95)

135 From Atoms to Quarks: An Introduction to the Strange World of Particle Physics.
James S. Trefil
(Pub price $12.95)

106 Without Me You're Nothing: The Essential Guide to Home Computers.
Frank Herbert with Max Barnard
(Pub price $14.95)

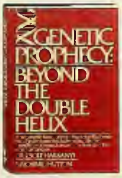
149 Science and the Supernatural. John Taylor
A distinguished physicist investigates psychic healing, telepathy, psychokinesis and other paranormal phenomena.
(Pub price $10.95)

Photograph © 1978 Alfred Gescheidt; The Image Bank

120 The Dancing Wu Li Masters: An Overview of the New Physics. Gary Zukav. The new physics clearly explained, revealing its surprising relationship to Zen. (Pub price $12.95)

181 An Imagined World: A Story of Scientific Discovery. June Goodfield How the discoveries are really made. "The best book about science since Loren Eiseley's *The Immense Journey*" —Freeman Dyson, author of *Disturbing the Universe*.
(Pub price $12.95)

146 Fieldbook of Natural History (Second Edition)
E. Laurence Palmer
Revised by H. Seymour Fowler. (Pub price $23.50)



172 Genetic Prophecy: Beyond the Double Helix.
Dr. Zsolt Harsanyi and Richard Hutton
(Pub price $13.95)

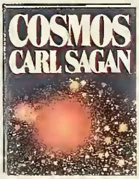
171 The Tigris Expedition: In Search of Our Beginnings. Thor Heyerdahl. High adventure and danger in an archaeological search for our beginnings.
(Pub price $17.95)

100 Einstein's Universe
Nigel Calder. A fascinating and lucid explanation of the theories that changed man's understanding of time, space and motion.
(Pub price $10)

167 Other Worlds: A Portrait of Nature in Rebellion; Space, Superspace and the Quantum Universe. Paul Davies. (Pub price $11.95)

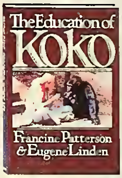
178 Dover Logic Books: *My Best Puzzles in Logic and Reasoning*, Hubert Phillips ("Caliban"); *Recreations in Logic*, D. G. Wells; *Test Your Logic: 50 Puzzles in Deductive Reasoning*, George J. Summers; *Puzzles in Math and Logic: 100 New Recreations*, Aaron J. Friedland.
(4 Vols.) *(Softcovers)*
(Pub prices total $7.50)

159 The Comet Is Coming! The Feverish Legacy of Mr. Halley. Nigel Calder
(Pub price $12.95)



103 Cosmos. Carl Sagan
(Pub price $22.95)

123 Lucy: The Beginnings of Humankind. Donald Johanson and Maitland Edey. (Pub price $16.95)

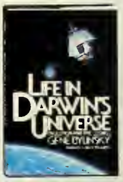


195 The Education of Koko
Francine Patterson and Eugene Linden
(Pub price $15.95)

184 Cosmic Discovery: The Search, Scope, and Heritage of Astronomy. Martin Harwit. From black holes to infrared galaxies, the unfolding story of today's astronomy and the men who are making the discoveries.
(Pub price $25)

187 Extinction: The Causes and Consequences of the Disappearance of Species. Paul and Anne Ehrlich.
(Pub price $14.95)

102 A Child Is Born (Revised Edition). Photographs by Lennart Nilsson. Text by Mirjam Furuhjelm, M.D., Axel Ingelman-Sundberg, M.D. and Claes Wirsén, M.D.
(Pub price $14.95)



197 Life in Darwin's Universe: Evolution and the Cosmos. Gene Bylinsky
(Pub price $17.95)

101 Mysteries of the Past
Text by Lionel Casson, Robert Claiborne, Brian Fagan and Walter Karp. Editor: Joseph J. Thorndike, Jr.
(Pub price $34.95)

125 Maps of the Mind
Charles Hampden-Turner
A voyage through man's seat of consciousness, illustrated with a series of fascinating diagrams, or "maps." (Pub price $14.95)

SCIENCE ARE IN ONE PLACE.

From: The Grand Tour © 1981 by Ron Miller and William K. Hartmann reprinted by arrangement with the Publisher

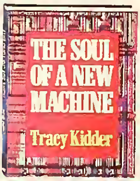
173 The Grand Tour: A Traveler's Guide to the Solar System. Ron Miller and William K. Hartmann (Pub price $19.95)

188 Celebrations of Life René Dubos. A Pulitzer Prize-winning biologist reflects on what makes us human, refuting the notion that we are genetically predetermined. (Pub price $12.95)

182 Are We Alone? The Possibility of Extraterrestrial Civilizations. Robert T. Rood and James S. Trefil (Pub price $14.95)

176 The Hite Report on Male Sexuality. Shere Hite (Pub price $19.95)

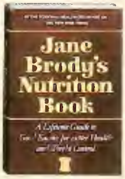
189 Photovoltaics: Sunlight to Electricity in One Step. Paul D. Maycock and Edward N. Stirewalt (Pub price $19.95)



175 The Soul of a New Machine. Tracy Kidder (Pub price $13.95)

107 The Panda's Thumb: More Reflections in Natural History. Stephen Jay Gould (Pub price $12.95)

198 Life Itself: Its Origin and Nature. Francis Crick (Pub price $12.95)



160 Jane Brody's Nutrition Book: A Lifetime Guide to

CHOOSE ANY 3 BOOKS FOR $1 EACH.

You simply agree to buy 3 books within two years.

Black holes twisting space and time like a pretzel—and gobbling down whole planets.

Here on Earth, the stunning adaptability of life: a desert animal that swims through sand the way an eel swims through water. And the ingeniousness of man: a new concept that may generate limitless electricity by duplicating the power of the sun.

And, in each of your cells—a substance called DNA, compressing into an invisibly tiny volume all the information needed to create *you*.

As someone living in an age of unparalleled discovery, you've undoubtedly been curious about things like these.

And you've probably noticed the explosion lately in books about science for people who are not scientists.

But how do you know which are best?

Let a whole new kind of book club find them for you. Book-of-the-Month Club/SCIENCE.

If you ever wanted the chance to really explore the wonders of modern science, this is the way. Because now you can be sure you're getting works that are understandable, lively and authoritative.

Book-of-the-Month Club/SCIENCE will lead you to books that indulge your sense of wonder to the fullest, sparkle with discovery, tantalize with new questions.

Books that can change your way of thinking. And the way you and your children live.

We invite you to start by taking any 3 for $1 each.

BOOK-OF-THE-MONTH CLUB
SCIENCE
WHERE THE WONDER IS

ɔf the Deserts. Frederic H. Wagner
18.95)

: The
of Competition.
lker
11.95)

162 Critical Path
R. Buckminster Fuller
Adjuvant: Kiyoshi Kuromiya
(Pub price $15.95)

he-Month Club/SCIENCE, Camp Hill, PA 17012

CHOOSE ANY 3 BOOKS FOR $1 EACH.

You simply agree to buy 3 books within two years

Facts about Membership

You receive the Book-of-the-Month Club/SCIENCE News® 15 times a year (about every 3½ weeks). Each issue reviews a *Main Selection* plus scores of Alternates. If you want the *Main Selection* do nothing. It will be shipped to you automatically. If you want one or more Alternate books—or no book at all—indicate your decision on the Reply Form always enclosed and return it by the date specified. *Return Privilege:* If the *News* is delayed and you receive the *Main Selection* without having had 10 days to notify us, you may return it for credit at our expense. *Cancellations:* Membership may be discontinued by either you or the Club, at any time after you have purchased 3 additional books.

Book-of-the-Month Club/SCIENCE
Camp Hill, Pennsylvania 17011

BS113-2

Please enroll me as a member of Book-of-the-Month Club/SCIENCE and send me the 3 books I've listed below, billing me $3, plus shipping and handling charges, for all 3 books. I agree to buy 3 more books during the next two years. A shipping and handling charge is added to each shipment.

Indicate by number the 3 books you want ☐ ☐ ☐

Mr.
Mrs.______________________________ 2-01
Miss (Please print plainly)

Address______________________________Apt.______

City______________________________

State______________________________Zip______

NOW ALL THE BEST BOOKS ABOUT

Q: Is this the only universe?

A: Reasoning from quantum theory, some scientists now believe there may be other universes in addition to our own—perhaps an infinite number of them! All of the universes, including ours, would be embedded in a mind-boggling entity called "superspace." (See *Other Worlds*)

Q: What common creature is a direct descendant of the dinosaurs?

A: There may be one perched on your windowsill right now—the *bird*. Not only are birds direct descendants of the dinosaurs, but some biologists think they're even eligible for the title "living dinosaurs." (See *Extinction*)

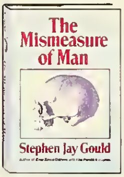
Q: What fish goes fishing complete with line and bait?

A: It's called an anglerfish. It looks like a rock, and thus camouflages itself on the ocean bottom. Coming out of its mouth is a thin, wiggly structure that resembles a piece of string. At the end of the "string" is another structure that looks exactly like a tiny fish—an exquisitely accurate fake complete with eye-like spots of pigment, fins and tail. When an unsuspecting fish tries to snare the decoy, the anglerfish makes a quick meal of the visitor. (See *The Panda's Thumb*)

DAVID ATTENBOROUGH
Life on Earth

199 Life on Earth: A Natural History. David Attenborough (Pub price $22.50)

119 Until the Sun Dies Robert Jastrow. A clear explanation of current scientific thought on the creation of the universe and the origins of life. (Pub price $8.95)

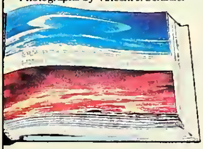


196 The Mismeasure of Man Stephen Jay Gould (Pub price $14.95)

124 The Origin of Consciousness in the Breakdown of the Bicameral Mind Julian Jaynes (Pub price $12.95)

180 Genesis: The Origins of Man and the Universe. John Gribbin. A time trip from the universe's birth to its probable end, showing mankind's place within it. (Pub price $13.95)

Photographs by Vincent J. Schaefer



161 A Field Guide to the Atmosphere. Vincent J. Schaefer and John A. Day (Pub price $13.95)

130 Sand Rivers. Peter Matthiessen. Photographs by Hugo van Lawick. A visit to Africa's largest and least accessible wildlife sanctuary with the author of *The Tree Where Man Was Born.* (Pub price $19.95)

179 Drawing on the
Side of the Brain: A (
in Enhancing Creati
Artistic Confidence.
Betty Edwards. *(So*
(Pub price $8.95)

135 From Atoms to
Quarks: An Introdu
the Strange World c
Particle Physics.
James S. Trefil
(Pub price $12.95)

106 Without Me You
Nothing: The Essen
Guide to Home Con
Frank Herbert with
Max Barnard
(Pub price $14.95)

149 Science and the
Supernatural. John
A distinguished phy
investigates psychic
healing, telepathy,
psychokinesis and c
paranormal phenon
(Pub price $10.95)

Photograph © 1978 Alfred Gescheidt; The Image Bank

120 The Dancing Wu Li Masters: An Overview of the New Physics. Gary Zukav. The new physics clearly explained, revealing its surprising relationship to Zen. (Pub price $12.95)

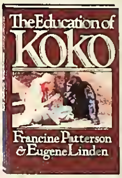
181 An Imagined World: A Story of Scientific Discovery. June Goodfield How the discoveries are really made. "The best book about science since Loren Eiseley's *The Immense Journey*" —Freeman Dyson, author of *Disturbing the Universe.* (Pub price $12.95)

146 Fieldbook of Natural History (Second Edition) E. Laurence Palmer Revised by H. Seymour Fowler. (Pub price $23.50)

167 Other Worlds: A Portrait of Nature in Rebellion; Space, Superspace and the Quantum Universe. Paul Davies. (Pub price $11.95)

178 Dover Logic Books: *My Best Puzzles in Logic and Reasoning,* Hubert Phillips ("Caliban"); *Recreations in Logic,* D. G. Wells; *Test Your Logic: 50 Puzzles in Deductive Reasoning,* George J. Summers; *Puzzles in Math and Logic: 100 New Recreations,* Aaron J. Friedland. (4 Vols.) *(Softcovers)* (Pub prices total $7.50)

159 The Comet Is Coming! The Feverish Legacy of Mr. Halley. Nigel Calder (Pub price $12.95)



195 The Education of Koko Francine Patterson and Eugene Linden (Pub price $15.95)

184 Cosmic Discovery: The Search, Scope, and Heritage of Astronomy. Martin Harwit. From black holes to infrared galaxies, the unfolding story of today's astronomy and the men who are making the discoveries. (Pub price $25)

187 Extinction: The Causes and Consequences of the Disappearance of Species. Paul and Anne Ehrlich. (Pub price $14.95)

102 A Child Is Born (Revised Edition). Photographs by Lennart Nilsson. Text by Mirjam Furuhjelm, M.D., Axel Ingelman-Sundberg, M.D. and Claes Wirsén, M.D. (Pub price $14.95)

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 2240 CAMP HILL, PA.

POSTAGE WILL BE PAID BY ADDRESSEE

BOOK-OF-THE-MONTH CLUB
SCIENCE
A Division of Book-of-the-Month Club, Inc.
Camp Hill, Pennsylvania 17011

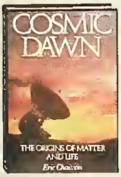
SCIENCE ARE IN ONE PLACE.

From: The Grand Tour © 1981 by Ron Miller and William K. Hartmann reprinted by arrangement with the Publisher

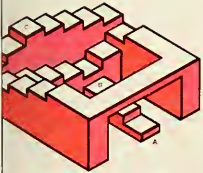
173 The Grand Tour: A Traveler's Guide to the Solar System. Ron Miller and William K. Hartmann (Pub price $19.95)

188 Celebrations of Life René Dubos. A Pulitzer Prize-winning biologist reflects on what makes us human, refuting the notion that we are genetically predetermined. (Pub price $12.95)

182 Are We Alone? The Possibility of Extraterrestrial Civilizations. Robert T. Rood and James S. Trefil (Pub price $14.95)



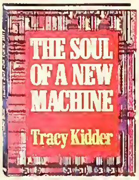
200 Cosmic Dawn: The Origins of Matter and Life. Eric Chaisson (Pub price $14.95)



111 Mathematical Circus Martin Gardner (Pub price $9.95)

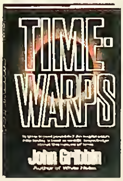
176 The Hite Report on Male Sexuality. Shere Hite (Pub price $19.95)

189 Photovoltaics: Sunlight to Electricity in One Step. Paul D. Maycock and Edward N. Stirewalt (Pub price $19.95)



175 The Soul of a New Machine. Tracy Kidder (Pub price $13.95)

185 Green Wisdom Arthur W. Galston (Pub price $12.95)

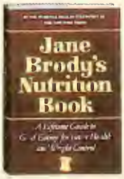


158 Timewarps. John Gribbin. A fascinating discussion of time—its history in human thought, current scientific knowledge and the possibilities of such things as time travel, parallel universes and reincarnation. (Pub price $8.95)

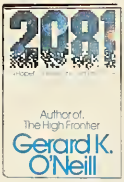
183 Basin and Range. John McPhee. (Pub price $10.95)

107 The Panda's Thumb: More Reflections in Natural History. Stephen Jay Gould (Pub price $12.95)

198 Life Itself: Its Origin and Nature. Francis Crick (Pub price $12.95)



160 Jane Brody's Nutrition Book: A Lifetime Guide to Good Eating for Better Health and Weight Control. Jane E. Brody (Pub price $17.95)



169 2081: A Hopeful View of the Human Future. Gerard K. O'Neill (Pub price $13.95)

177 The Stories Of Ray Bradbury. With an Introduction by Ray Bradbury (Pub price $17.95)

CHOOSE ANY 3 BOOKS FOR $1 EACH.

You simply agree to buy 3 books within two years.

Black holes twisting space and time like a pretzel—and gobbling down whole planets.

Here on Earth, the stunning adaptability of life: a desert animal that swims through sand the way an eel swims through water. And the ingeniousness of man: a new concept that may generate limitless electricity by duplicating the power of the sun.

And, in each of your cells—a substance called DNA, compressing into an invisibly tiny volume all the information needed to create *you*.

As someone living in an age of unparalleled discovery, you've undoubtedly been curious about things like these.

And you've probably noticed the explosion lately in books about science for people who are not scientists.

But how do you know which are best?

Let a whole new kind of book club find them for you. Book-of-the-Month Club/SCIENCE.

If you ever wanted the chance to really explore the wonders of modern science, this is the way. Because now you can be sure you're getting works that are understandable, lively and authoritative.

Book-of-the-Month Club/SCIENCE will lead you to books that indulge your sense of wonder to the fullest, sparkle with discovery, tantalize with new questions.

Books that can change your way of thinking. And the way you and your children live.

We invite you to start by taking any 3 for $1 each.

BOOK-OF-THE-MONTH CLUB
SCIENCE
WHERE THE WONDER IS

Belinda Wright

153 Wildlife of the Deserts. Frederic H. Wagner (Pub price $18.95)

190 Winning: The Psychology of Competition. Stuart H. Walker (Pub price $11.95)

162 Critical Path R. Buckminster Fuller Adjuvant: Kiyoshi Kuromiya (Pub price $15.95)

Book-of-the-Month Club/SCIENCE, Camp Hill, PA 17012 cal messages might still populate nature. Thus, St. George Mivart, one of Darwin's most effective evolutionary critics and a devout Catholic, argued that "many amiable and excellent people" had been misled by the apparent suffering of animals for two reasons. First, however much it might hurt, "physical suffering and moral evil are simply incommensurable." Since beasts are not moral agents, their feelings cannot bear any ethical message. But secondly, lest our visceral sensitivities still be aroused, Mivart assures us that animals must feel little, if any, pain. Using a favorite racist argument of the time—that "primitive" people suffer far less than advanced and cultured people—Mivart extrapolated further down the ladder of life into a realm of very limited pain indeed: Physical suffering, he argued,

> depends greatly upon the mental condition of the sufferer. Only during consciousness does it exist, and only in the most highly organized men does it reach its acme. The author has been assured that lower races of men appear less keenly sensitive to physical suffering than do more cultivated and refined human beings. Thus only in man can there really be any intense degree of suffering, because only in him is there that intellectual recollection of past moments and that anticipation of future ones, which constitute in great part the bitterness of suffering. The momentary pang, the present pain, which beasts endure, though real enough, is yet, doubtless, not to be compared as to its intensity with the suffering which is produced in man through his high prerogative of self-consciousness [from *Genesis of Species*, 1871].

It took Darwin himself to derail this ancient tradition—in that gentle way so characteristic of his radical intellectual approach to nearly everything. The ichneumons also troubled Darwin greatly and he wrote of them to Asa Gray in 1860:

> I own that I cannot see as plainly as others do, and as I should wish to do, evidence of design and beneficence on all sides of us. There seems to me too much misery in the world. I cannot persuade myself that a beneficent and omnipotent God would have designedly created the Ichneumonidae with the express intention of their feeding within the living bodies of Caterpillars, or that a cat should play with mice.

Indeed, he had written with more passion to Joseph Hooker in 1856: "What a book a devil's chaplain might write on the clumsy, wasteful, blundering, low, and horribly cruel works of nature!"

This honest admission—that nature is often (by our standards) cruel and that all previous attempts to find a lurking goodness behind everything represent just so much absurd special pleading—can lead in two directions. One might retain the principle that nature holds moral messages for humans, but reverse the usual perspective and claim that morality consists in understanding the ways of nature and doing the opposite. Thomas Henry Huxley advanced this argument in his famous essay on *Evolution and Ethics* (1893):

> The practice of that which is ethically best—what we call goodness or virtue—involves a course of conduct which, in all respects, is opposed to that which leads to success in the cosmic struggle for existence. In place of ruthless self-assertion it demands self-restraint; in place of thrusting aside, or treading down, all competitors, it requires that the individual shall not merely respect, but shall help his fellows. . . . It repudiates the gladiatorial theory of existence. . . . Laws and moral precepts are directed to the end of curbing the cosmic process.

The other argument, more radical in Darwin's day but common now, holds that nature simply is as we find it. Our failure to discern the universal good we once expected does not record our lack of insight or ingenuity but merely demonstrates that nature contains no moral messages framed in human terms. Morality is a subject for philosophers, theologians, students of the humanities, indeed for all thinking people. The answers will not be read passively from nature; they do not, and cannot, arise from the data of science. The factual state of the world does not teach us how we, with our powers for good and evil, should alter or preserve it in the most ethical manner.

Darwin himself tended toward this view, although he could not, as a man of his time, thoroughly abandon the idea that laws of nature might reflect some higher purpose. He clearly recognized that the specific manifestations of those laws—cats playing with mice, and ichneumon larvae eating caterpillars—could not embody ethical messages, but he somehow hoped that unknown higher laws might exist "with the details, whether good or bad, left to the working out of what we may call chance."

Since ichneumons are a detail, and since natural selection is a law regulating details, the answer to the ancient dilemma of why such cruelty (in our terms) exists in nature can only be that there isn't any answer—and that the framing of the question "in our terms" is thoroughly inappropriate in a natural world neither made for us nor ruled by us. It just plain happens. It is a strategy that works for ichneumons and that natural selection has programmed into their behavioral repertoire. Caterpillars are not suffering to teach us something; they have simply been outmaneuvered, for now, in the evolutionary game. Perhaps they will evolve a set of adequate defenses sometime in the future, thus sealing the fate of ichneumons. And perhaps, indeed probably, they will not.

Another Huxley, Thomas's grandson Julian, spoke for this position, using as an example—yes, you guessed it—the ubiquitous ichneumons:

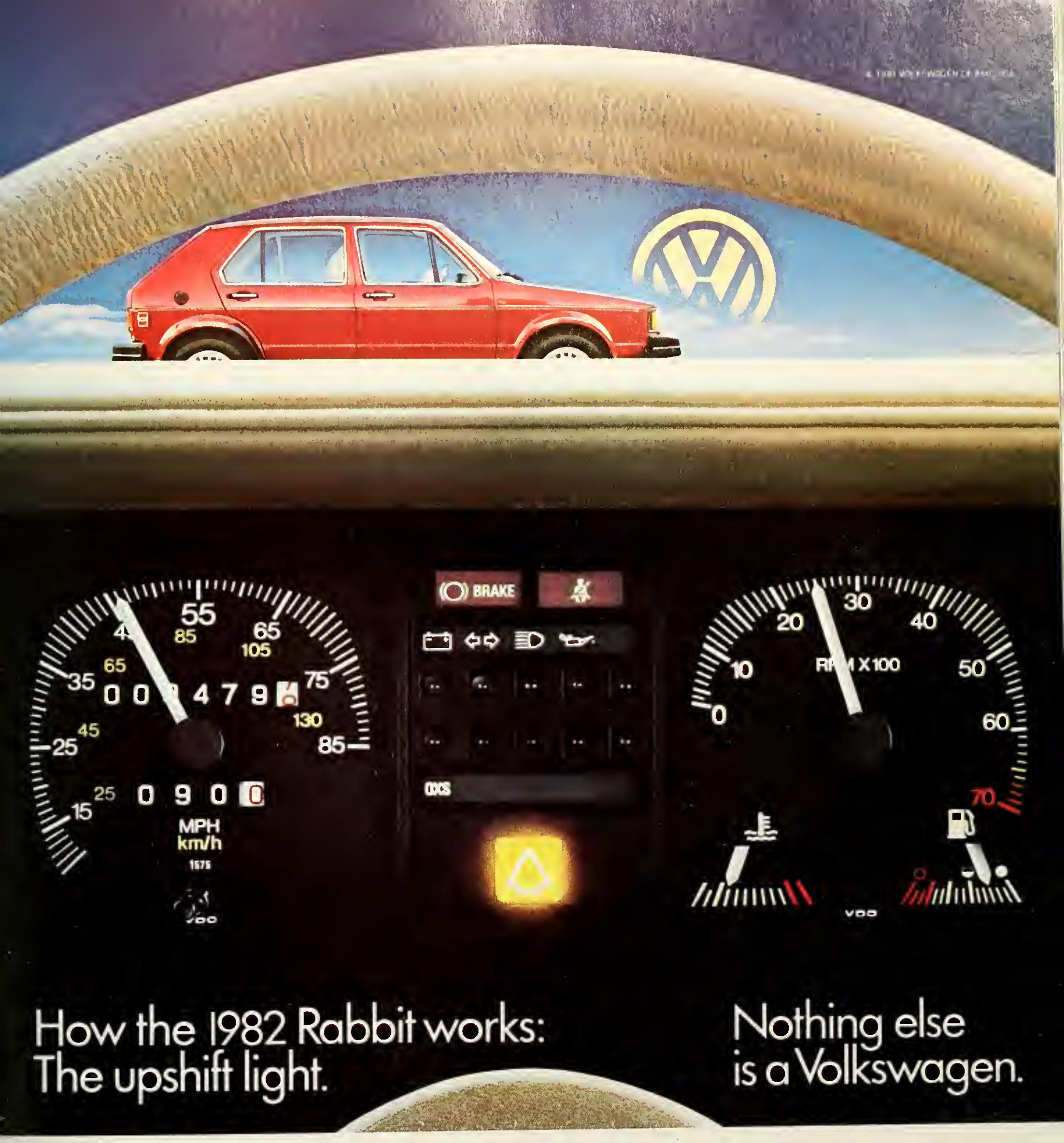
> Natural selection, in fact, though like the mills of God in grinding slowly and grinding small, has few other attributes that a civilized religion would call divine. . . . Its products are just as likely to be aesthetically, morally, or intellectually repulsive to us as they are to be attractive. We need only think of the ugliness of *Sacculina* or a bladder-worm, the stupidity of a rhinoceros or a stegosaur, the horror of a female mantis devouring its mate or a brood of ichneumon flies slowly eating out a caterpillar.

It is amusing in this context, or rather ironic since it is too serious to be amusing, that modern creationists accuse evolutionists of preaching a specific ethical doctrine called secular humanism and thereby demand equal time for their unscientific and discredited views. If nature is nonmoral, then evolution cannot teach any ethical theory at all. The assumption that it can has abetted a panoply of social evils that ideologues falsely read into nature from their beliefs—eugenics and (misnamed) social Darwinism prominently among them. Not only did Darwin eschew any attempt to discover an antireligious ethic in nature, he also expressly stated his personal bewilderment about such deep issues as the problem of evil. Just a few sentences after invoking the ichneumons, and in words that express both the modesty of this splendid man and the compatibility, through lack of contact, between science and true religion, Darwin wrote to Asa Gray,

> I feel most deeply that the whole subject is too profound for the human intellect. A dog might as well speculate on the mind of Newton. Let each man hope and believe what he can.

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

© 1981 VOLKSWAGEN OF AMERICA



How the 1982 Rabbit works: The upshift light.

Nothing else is a Volkswagen.

People drive cars with stick shifts for two reasons. They're fun. And, they're economical.

With this in mind, VW engineers have developed a unique Formula-E System upshift light for all gas and diesel Rabbits. And, for all their other cars.

The light's electronic brain monitors and analyzes engine speed, engine load and gear selection. Then, the dashboard light comes on to tell you precisely when to shift to get the most car performance for the least fuel consumption.

Following it faithfully could get you about 7% better mileage than last year's Rabbit. Thus, the light frees you to revel in all the Rabbit's other built-in advantages. Like front-wheel drive. Sprightly pickup. And superb handling.

Yet all the while, you'll be driving it nearly as perfectly as the EPA says you can. And maybe even better.

Diesel EPA is 58 highway estimate, and an estimated $\boxed{45}$ mpg. (Use "estimated mpg" for comparisons. Actual mileage may vary with weather, speed and trip length. Actual highway mileage will probably be less.)

Enchantment of the Fasnacht

Tradition and propriety rule Basel's carnival

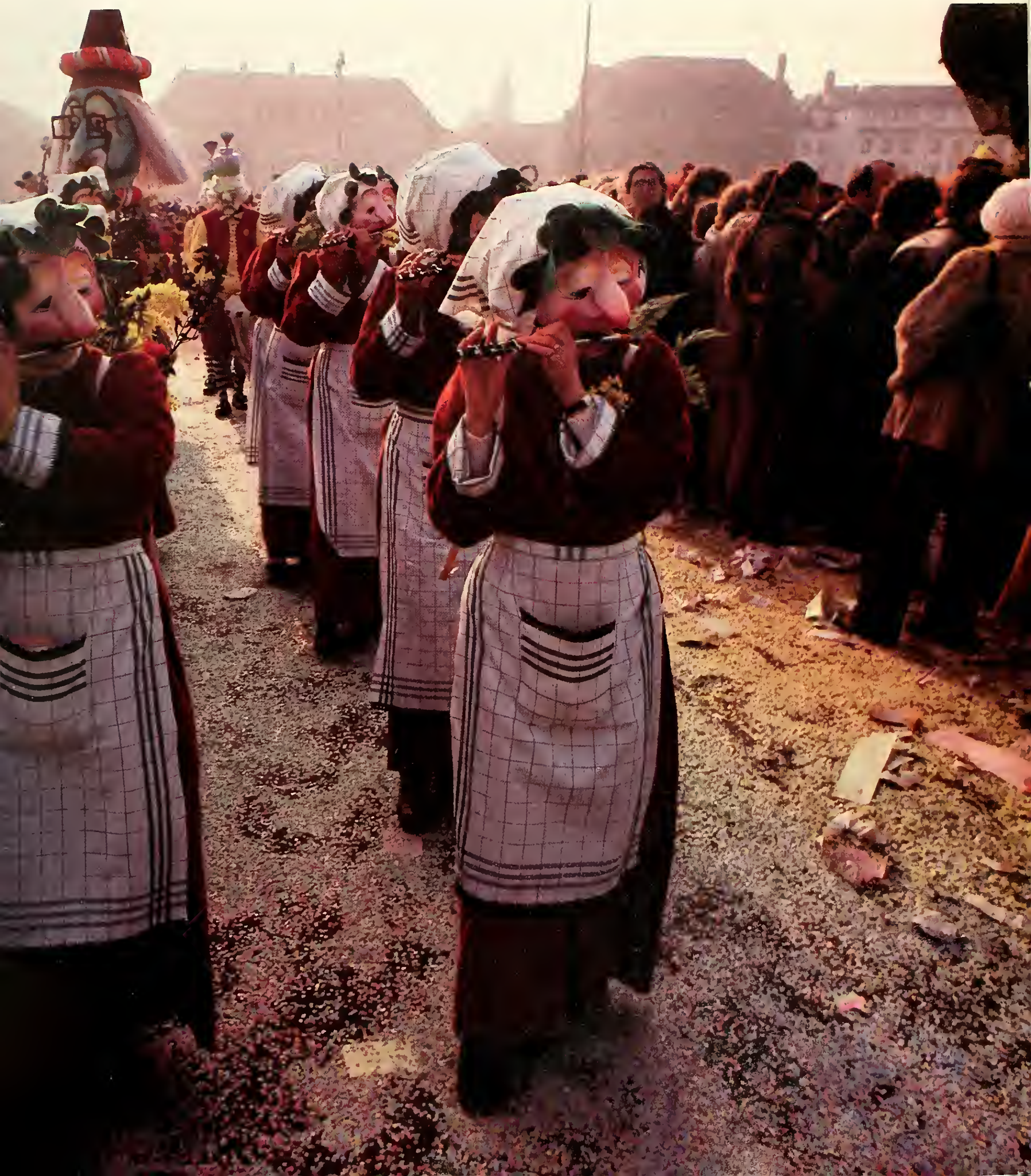
by Donna Lauren Gold **photographs by Alexander Orloff**

It is just before four o'clock on a cold winter morning in Basel, Switzerland's industrial, yet charming, inland port. Normally, the city would be dark and deserted at this hour, with only a few stragglers wending their way home after the bars have closed. But because this is the Monday after Ash Wednesday, all the cafés and bars are still open, and every inch of space in the downtown area is taken up by people from Basel and beyond. It is the morning of the *Morgeschtraich*, the "morning stroke" or "morning prank" that opens the Fasnacht, Basel's yearly carnival.

At the stroke of four, every light in Basel, in every home and on every street, is extinguished. The suddenness and completeness of the blackout is a visual shock, yet there is barely time to take it in, for already the music has begun: a slow, rhythmic tune, played in unison on high-pitched pipe and droning drum, arises from all the streets and alleyways in central Basel. And now the players emerge; lit by lanterns borne on their heads, they float through the crowds, their faces hidden behind ghoulish and sad-faced masks.

For a moment the crowd stands hushed, caught by the spell. Then the excitement takes over, the pushing starts, and one must follow the swaying mass until it unravels itself. Throughout the rest of the night and into the dawn the people walk around, following different groups on their journey through the town, taking their first look at the intricately crafted costumes, and crowding into restaurants for the traditional Fasnacht food—bland flour soup and onion pie. The spell comes and goes as the experience of the carnival competes

Observers are easy to distinguish from active participants in the Fasnacht, Basel's yearly carnival. Dominating the carnival are the Cliquen, *groups that are costumed according to chosen themes and whose members play piccolos and drums. Here, a* Clique *makes its way down confetti-covered streets during one of the afternoon parades that mark the three-day celebration.*

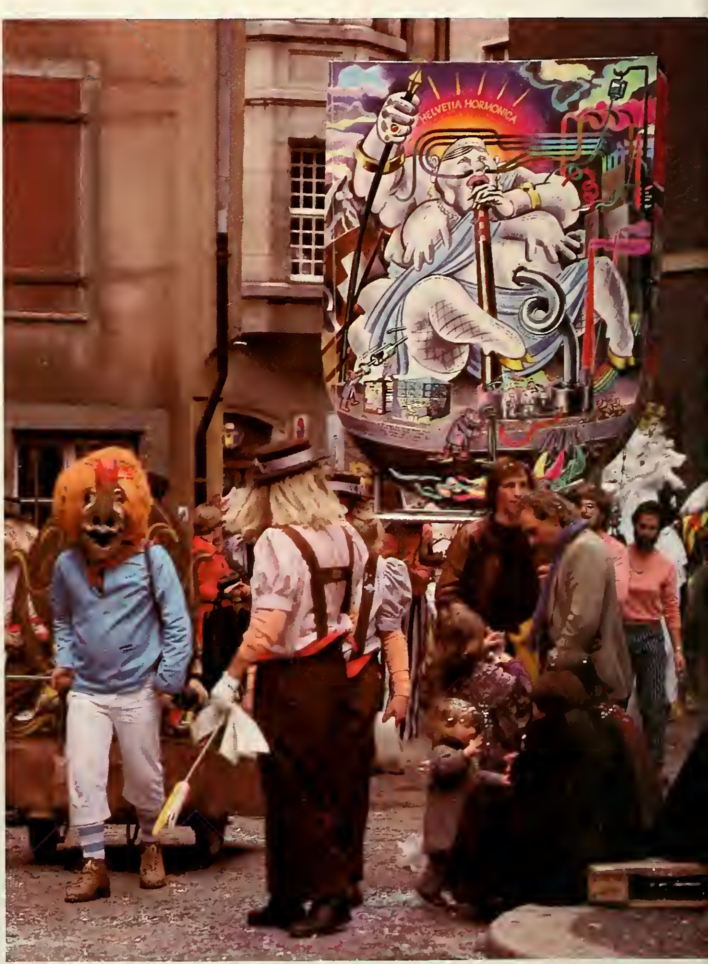


with the normal socializing of people out for a good time. At 5:00 A.M., while waiting for a table in a restaurant, I casually looked out into the dark courtyard from a second-story window—there below me, a group of harlequins, illuminated by their lanterns, slowly circled in rhythmic pace to the music. I called my friends over, and we watched, transported back in time.

European-style carnivals are thought to have originated in Babylon and can be traced through Roman Saturnalias. Since so many other societies around the world have festivals with similar elements, however, they all may have an even older derivation. The elements associated with these festivals include the suspension of ordinary routines and a reversal of roles—the lowly are raised high, the jester becomes king or priest, men act as women and women as men, humans turn into animals. All participants are masked and wear costumes. The disguises facilitate a general relaxation of rules, resulting in varying degrees of licentiousness and the freedom to criticize neighbors or town officials, usually through satire. During the Middle Ages all sorts of social breaches—especially illicit liaisons and unusual marriages—were the targets of embarrassing carnival antics. Today the aggression is playful and relatively indiscriminate. In Nice, flowers are thrown; in Basel, confetti.

Historically, European carnivals existed in an uneasy relationship to the authorities, being alternately condoned as a safety valve and banned as sacrilegious and dangerous. These fears were not unfounded. During the carnival of 1376 in Basel, a rebellion broke out

Below: A Clique *displays its theme on a beautifully rendered* sujet *lantern, which, according to custom, is unsigned. Even Marc Chagall did not sign the lantern he painted one year. Right: A caricature of the Alsatian peasant, a* Waggis *rides a hay wagon from which confetti is thrown at the crowds.*



against the ruling Austrians, culminating in the beheading of twelve citizens and the banishment of the city from the empire. In 1529, masqueraders entered the Basel Cathedral and Assembly Hall and forced the government to yield to a wider democratization of its laws. France and Germany also have had their share of carnival rebellions.

The Christian church incorporated carnivals as a pre-Lenten festival, but they became less widespread in Europe following the Reformation, which abolished most festivals as well as the Lenten season. Industrialization, with its emphasis on labor productivity, also may have curtailed such recreation. The extravagant silliness of carnivals, which "wasted" time as well as money, could not be tolerated once a person's time was given a monetary value. Nevertheless, carnivals are celebrated today in some form in scattered cities in Belgium, France, Portugal, Spain, Italy, Greece, Hungary, Russia, Austria, and Germany, as well as Switzerland. Basel is the only major Protestant city that still holds a traditional carnival. To separate the Fasnacht from religious associations, Baslers begin their three-day festival on the Monday after Ash Wednesday, a week later than most carnivals are held and after Catholics have already begun Lent. (In 1982, the Fasnacht begins March 1.)

There are several ways people can participate actively in the Basel Fasnacht. The formal groups that make up the large parades are the *Cliquen*, the *Guggemuusig* groups, and the *Waggiswaage*. The *Cliquen* are the main organizations, groups of 25 to 200 people who wear costumes and masks and play piccolos and drums. The large *Cliquen* are divided into two or three more or less independent divisions. Counting divisions separately, there are about 100 such groups, with an average of forty people in each.

The *Cliquen* open the festivities with the *Morgeschtraich*, and they provide the musical undertone for the festival. Many of the traditional tunes are fife-and-drum marches that were brought home by Swiss mercenary soldiers. On Monday and Wednesday afternoons, all the *Cliquen* march together in a parade and present their themes for the year—painted on huge, rectangular *sujet* lanterns, outlined in handbills, and often expressed in the costumes themselves. At other times they wander through the town, either as individuals or in small groups, playing their instruments and seemingly lost to the world behind their masks.

Considerable training is required to be a member of a *Clique*, as only expert drummers and pipers are allowed. One must also have a certain amount of cash to pay for the costume and the mask. Through the sale of Fasnacht *Plaketten*, or "pins," some, but not all, of this outlay is recovered. In return for their devotion, the participants experience the joys of membership, ranging from near obsession with Fasnacht themes to a genuine sense of brotherhood (and sisterhood—women are also participants, though not in equally large numbers). This sense of community, arising from mutual experience, was considered to be a *Clique*'s most remarkable aspect by one former member. Another told me of the tears that end the final ball as the

GUGGE-MUSIG
TRÄNE-FURZER

members realize they must go about their separate concerns until the next carnival season. Like college or fraternity ties, Fasnacht connections form a network that can be called upon when there is a need for special favors.

A second large body of participants are members of *Guggemuusig* groups, a recent addition to the Fasnacht. These are similar to the *Cliquen* in that each member of a particular group will wear a variation on a chosen costume and each must play an instrument, but the music itself is a parody. *Guggemuusig*, literally translated, means "music from paper bags." As one man explained, "If you took an old paper bag and blew into it, you wouldn't have very good music, would you?" *Guggemuusig* musicians play out-of-tune distortions of traditional marches and Dixieland jazz tunes, in the style of Mardi Gras musicians. Their instruments range from real drums and horns to noisemakers improvised from vacuum cleaner tubes and toilet fixtures. *Guggemuusig* groups officially debut on Tuesday night with a concert and large parade, although some come out earlier. Within the Fasnacht they are an energetic contrast to the marching tunes of the *Cliquen*, whose music is lovely but repetitious.

A third—and expensive—means of participating in the parades is to bring in a *Waggiswaage*, a large hay wagon loaded with flowers, oranges, confetti, and candy with which to pelt the crowds. The *Waggis* who ride the wagon wear wooden clogs and masks topped with wild, bushy hair, often colored bright green or orange. They are caricatures of the Alsatian peasants who for centuries have come to Basel marketplaces, hawking fruits and vegetables.

Left: Masks of a Guggemuusig *group lie in wait while the musicians take a break. Only grudgingly tolerated by some tradition-minded Baslers,* Guggemuusig *groups play out-of-tune distortions of marches and Dixieland jazz tunes. Below: To embarrass or fluster observers, masked participants engage in playful assaults using confetti or verbal teasing.*

There are also several less formal ways of participating. Increasingly popular are groups of two to eight people who, like the members of *Cliquen*, roam the streets playing piccolos and drums. Although they are referred to as *Schyssdragg-ziigli* ("little nothings"), these groups have as many people as the *Cliquen* themselves. Unlike the *Cliquen*, however, they do not march in the official parades or prepare topical *sujet* lanterns and handbills; they are also considered more anarchistic.

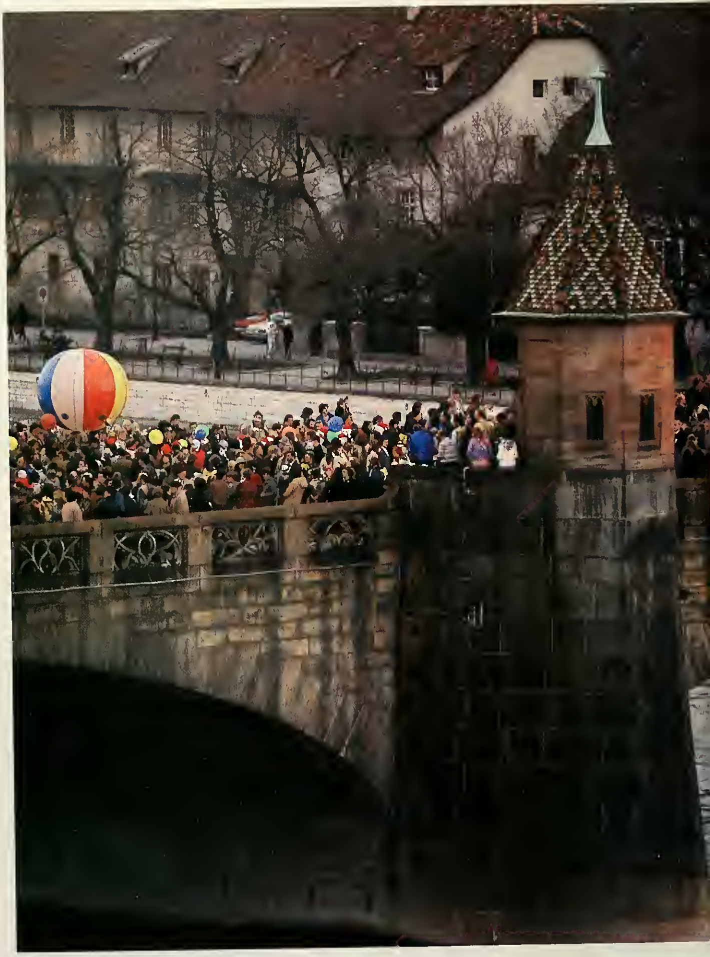
Other people choose to be part of a *Schnitzelbangg* group (the name is derived from a term for "town crier"). These small groups of two to six people travel through certain cafés on the Monday and Wednesday nights of the carnival and recite satirical verses, accompanied by some form of music (a child's toy piano will do) and illustrated with posters or props. The subject of the satire generally comes from the past year's news, and local politicians, who are more or less required to make an appearance at one of the cafés on the circuit, are often mocked. In this the *Schnitzelbangg* groups differ from the *Cliquen*, whose satires generally exclude local issues. And while the members of a *Clique* organize and practice their presentation months in advance, a *Schnitzelbangg* group need only submit its topic to a jury on the Friday before the carnival, to insure that the performance is up to standard and that the subject matter is not obscene.

Finally, one may decide to go it alone—as an *Einzelmaske*, or "single mask." This may be a particularly outlandish costume or a traditional one, such as the *Waggis*, the *Alte Tante* ("old aunt"), or the *Kritte* ("sexy, sassy girl"). Those who venture out in traditional roles are expected to *intrigieren*, to verbally assault innocent bystanders or chosen targets with showers of clever invectives concerning anything from the clothes their victims are wearing to vague allusions to their pasts.

Participants in the Fasnacht come from a cross section of Basel citizenry. Translated into contemporary Swiss terms, this means anyone from the middle or upper class. In the industrial and business centers there is really no lower class among the citizens of Switzerland. That position is occupied by foreign workers, generally Italians, Yugoslavs, Greeks, Turks, and Spaniards.

During the outdoor celebrations of the Fasnacht there is a clear separation between participants and observers: participants are the only ones permitted to wear masks and costumes. Sometimes youths from France or Germany will try to join in the fun by getting dressed up and putting on a mask, but this is frowned upon. The special quality of Basel's Fasnacht is that it remains traditional. Participants in the parades must belong to one of the traditional groups (and even the *Guggemuusig* groups are only grudgingly tolerated by some, who feel that they approach the general unruliness and obscenity associated with German carnivals). The closest an observer can come to being an active part of the Fasnacht is to fall in step behind the members of a particular *Clique*, following them in their meanderings through the town. Indoors, in the restaurants, the distinctions become blurred,

On the Monday and Wednesday afternoons of the three-day carnival, participants march together in large parades through streets lined with observers. Below: A parade crosses the Rhine on the ancient Mittlere Bridge.



as participants take off their masks to indulge in wine and food; and late at night, nonparticipants join the others in masked balls.

The *Komittee* that oversees the celebrations is a small group of men from the older *Cliquen.* This conservative body is in charge of selling the Fasnacht *Plaketten* and distributing the funds back to the *Cliquen.* They set up a stand on the parade route where points are awarded to the *Cliquen* for the effort, talent, and originality shown in their costumes, masks, and lanterns. This point system helps to determine how much money will be distributed to the various groups. Other criteria include the number of members in a *Clique* and the number of times that it passes by the stand. Groups are thus rewarded for conforming to the ordered route.

The *Komittee* also insures that participants stay within certain bounds of propriety. For instance, one year a *Schnitzelbangg* pair illustrated their theme with a poster using the graffito shorthand for male genitalia as part of a man's face. The *Komittee* found this obscene and rejected the poster, so the pair placed a "censored" band over it—but at each restaurant they offered revelers a peek.

This sense that there are limits on what is acceptable is what sets the Basel Fasnacht apart from other carnivals, especially those in neighboring Germany. While other carnivals imply licentiousness and sexual freedom, the Fasnacht attempts to steer clear of anything touching on vulgarity. Only at the balls late at night is flirting with other than one's life partner permitted, although I was told that some couples separate on Monday at 4:00 A.M. and do not see each other until Thursday—no questions asked. In Germany parades may contain floats of huge women with their breasts bared and legs outspread; in Basel, however, the humor is most definitely not lewd, but rather political, and often focuses on exaggerations and word plays on the Basel dialect. At one point during the Fasnacht, I passed by a statue of a man holding a cigar. Someone had placed a bratwurst in its mouth and an empty bottle in its extended hand, and had wrapped the body with paper streamers. When I returned a short time later with my camera, these decorations had all been removed. Evidently someone else felt this mild playfulness was overly disrespectful.

Other Swiss towns holding carnivals allow somewhat more individual creativity and a slightly more general release. In Zurich, the carnival is relatively new, and consists mostly of masqueraders roaming from café to café, playing tricks, singing songs, getting drunk, and eventually ending up at the artists' ball, which culminates at 6:00 A.M. with a long snake dance. Lucerne holds a more traditional carnival, with parades similar to, but not so elaborate as, Basel's. As the official parade wanders through Lucerne, it is met by a "students'" parade, which includes pantomime as well as masquerades. Groups build their own stage sets on the streets and perform skits in them. One year a group dressed as mice erected a portable cage with a large wheel. They used the wheel to demonstrate how adept the human-sized mice were at completing their tricks. Compared with the extravagances we associate with Mardi Gras in

Overleaf: *Each Fasnacht mask and costume is beautifully finished. Some of the disguises are witty and satirical, while others—like those of these piccolo players—evoke ages gone by.*

Left: Separating from the overwhelming crowds, participants may wander individually or in small groups, playing their musical instruments. Below: Brass horns are their mainstay, but the Guggemuusig *musicians also improvise their own odd noisemakers.*

New Orleans and Rio, however, these kinds of revelry certainly seem tame.

In many ways, any form of carnival seems to be an anomaly in Switzerland. The Swiss see themselves as a "little people" who must hold together against the larger countries that surround them. Since their nation is divided into French-, Italian-, and German-speaking areas, as well as into Catholic and Protestant populations, the Swiss have had to suppress their natural allegiances in order to forge a national identity. This has taken the form of a self-conscious control over their lives, and is evident in the way the Swiss monitor themselves and others, in their conservatism, and in their products, which are known for quality of craftsmanship. Schedules are adhered to, streets are immaculate, crime is very low, and trams run on an honor system that is actually obeyed. Perhaps most telling are the international relationships of the Swiss. Their neutrality in international affairs insulates them against what they cannot hope to control. They also insulate themselves through their policy toward the foreign workers who make up about one-fifth of the population. Because their labor is necessary, these workers are welcome to remain in the country, but they are seldom granted citizenship. In this way, Switzerland can remain unaffected by world population movements and provide a high standard of living for its small, well-educated citizenry.

The strong sense of law and order that characterizes Switzerland would appear to resist the lifting of rules implicit in a carnival. And, indeed, participation is controlled in the Basel carnival, a showpiece of creativity in which the objects

to be satirized are often from outside Basel, if not outside Switzerland. The satires concern many issues: male chauvinism, feminism, the new McDonald's franchise in Basel (the first such fast-food establishment and an innovation not generally appreciated), gas prices, jogging, American presidents, Margaret Thatcher. In 1980, when French-speaking people in the Bern canton were agitating for a separate canton (eventually they succeeded), Baslers satirized the separatists. Even the anarchistic youth riots that shocked the northern cities in 1980 became a target of the 1981 Fasnacht. Although the political impact of the satires is limited, they may give Baslers some sense of control over perplexing issues. In addition, they are an important outlet for an educated body of people who, living in a nation that has backed off from public international involvements, have few means of expressing themselves about political matters beyond their borders.

The Fasnacht can be seen as an affirmation of Basel and its traditional values, which are held stubbornly against the encroachment of foreign ways. The intricate costumes, masks, and lanterns; the music, wit, and structured order of the carnival are, for the Baslers, a statement that they can celebrate without losing their civilized behavior. They also celebrate themselves explicitly by making constant jokes and references to the "Basler Bebbi," just as people in the northeastern United States might refer to themselves as "Yankees." In 1980 little flags were distributed with the slogan *Bebbi an der Macht* ("baby to power"), referring to hopes that the canton of the city of Basel would obtain representation on the seven-member Federal Council, the executive body of Switzerland. The exaggerated use of their dialect—for example, in pointed jabs at Zurich, their economic and social rival—is another way that Baslers celebrate their identity. Even the spelling *Fasnacht* stands as an expression of superiority and iconoclasm: for Germanic carnivals elsewhere, the spelling *Fastnacht* is used.

At the same time, the carnival itself cannot help but transform the city. In the central downtown area of Basel, traffic is prohibited for the three days of the festival. One may wander down the middle of the largest streets, now softened by the pastel shades of fallen confetti. There is always some new costume or an intricate lantern to inspect, and there is no reason to fear missing an act, because the action is occurring everywhere. The music permeates the town, drifting into the apartments of those who attempt to hide from the carnival atmosphere; routines are upset by the hours of the celebration, and work is only intermittent. Many of the spectators, along with the participants, even change the way they walk, taking on a common swaying dance step—a pause and a step, a pause and a step—swinging their legs out and around in time to the music. Although not all Baslers attend it (many escape the town for the ski slopes), the Fasnacht does bridge social boundaries, neutralizing them for a brief period of time.

For 362 days during the year, Basel is a town that also holds a carnival. Once the *Morgeschtraich* darkens the city, however, Basel becomes a mere backdrop, and Baslers are forced to accept a new definition of what is normal. Such an event, experienced individually, could be frightening and alienating, but the theater of the carnival transforms the experience into a communal celebration of what is possible beyond the conventions of daily life.

The disturbance of routines helps Baslers to witness the created nature of their social life. For that is what any festival does: it points out the force of the order within which people live, while at the same time giving them a short break from that order. This substitution is a critique of the general routine, but in this case also reinforces it, by showing how crazy, how disorienting life would be if people weren't bound by routine. By staying up for three nights in a row, Baslers recognize the need for sleep. By walking around behind a mask, unable to show any kind of expression, they learn the importance of real communication.

At 6:00 A.M. on the Thursday following the Fasnacht, one can still see *Cliquen* on the street, now carrying their masks under their arms, in a tired shuffle home. As the sun rises over Basel that morning, the last traces of confetti are being cleaned up, the traffic begins to move freely, and the city is once again transformed, this time back to a center of serious business. ☐

The Coming Solar Age

As the world moves through the last decades of the twentieth century, countries will draw their energy more and more from renewable resources

by Lester R. Brown

Illustrations by Chris Spollen

In retrospect, the year 1973, when oil prices abruptly rose fourfold, can be said to represent a turning point in global energy sources, marking the irrevocable end of the age of cheap and plentiful oil. As world oil production falls and the curtain begins to descend on the age of oil, the world is looking for alternative energy sources. Coal can help in the near term, but like oil, it too is exhaustible. It differs from oil only in that the remaining reserves are greater. Nuclear power, once projected to be the long-term replacement for oil, holds little promise. Its epitaph has been written, not by environmentalists, but by Wall Street, which has turned its back on the industry.

This leaves the world with solar, or renewable, energy. In effect, humanity must tap the current inflow of solar energy, substituting it for the solar energy from eons ago that was stored underground in the form of fossil fuels. New technologies and the adaptations of traditional ones permit solar energy to be harnessed in numerous ways. It can be captured mechanically, through such devices as windmills, hydroelectric generators, rooftop collectors, photovoltaic cells, and buildings incorporating solar architecture, or biologically, through forests, fuelwood plantations, and energy crops. In addition, geothermal energy, available on such a vast scale that it can be considered renewable, holds great promise. While each country's energy strategy must be tailored to its indigenous endowment of solar energy resources, and no two countries have precisely the same endowment, no nation is without some solar potential. In fact, quietly but decisively, the world has already begun the transition to a sustainable energy system based on renewable resources.

Wood as a Fuel

Before the 1973 oil price rise, wood's share of the global energy budget was shrinking. In almost all countries, its importance was declining relative to that of other fuels, and in many countries its use was declining in absolute terms as well. In the industrial nations, wood was almost entirely abandoned as a fuel during the era of cheap oil. Within the Third World, a combination of cheap postwar oil, rapid urbanization, and deforestation diminished wood's relative importance as a fuel.

With the surge in oil prices starting in 1973, wood began making a strong comeback. Besides its use in home cooking and heating, wood is also a suitable fuel for producing heat for industrial processes and for generating electricity. Within the developing countries, wood's many uses translate into extra pressure on local forest resources. In some countries, the use of wood also translates into a strong interest in fuelwood plantations.

The industrial countries, particularly those with abundant forest resources, have increased their use of wood dramatically since 1973. Nowhere is this more evident than in the United States, where wood has eclipsed nuclear power, providing 2.6 percent of the nation's delivered energy in 1980 compared with 1.2 percent for nuclear. By 1981, almost a tenth of all U.S. residences were burning wood as either a primary or a secondary source of heat. An estimated eight million wood stoves and furnaces were being used for residential heating in the United States.

The shift to wood use was most dramatic in New England, although it was plainly evident in Appalachia, the Great Lakes states, the Northwest, and other heavily wooded areas. In Vermont, New Hampshire, and Maine, 20 percent of all homes were burning wood as the primary source of heat by 1980. In two-thirds of the remaining homes in the region, wood provided a secondary source of heat. So swift was the conversion that the revived stove- and furnace-manufacturing industry was swamped by demand.

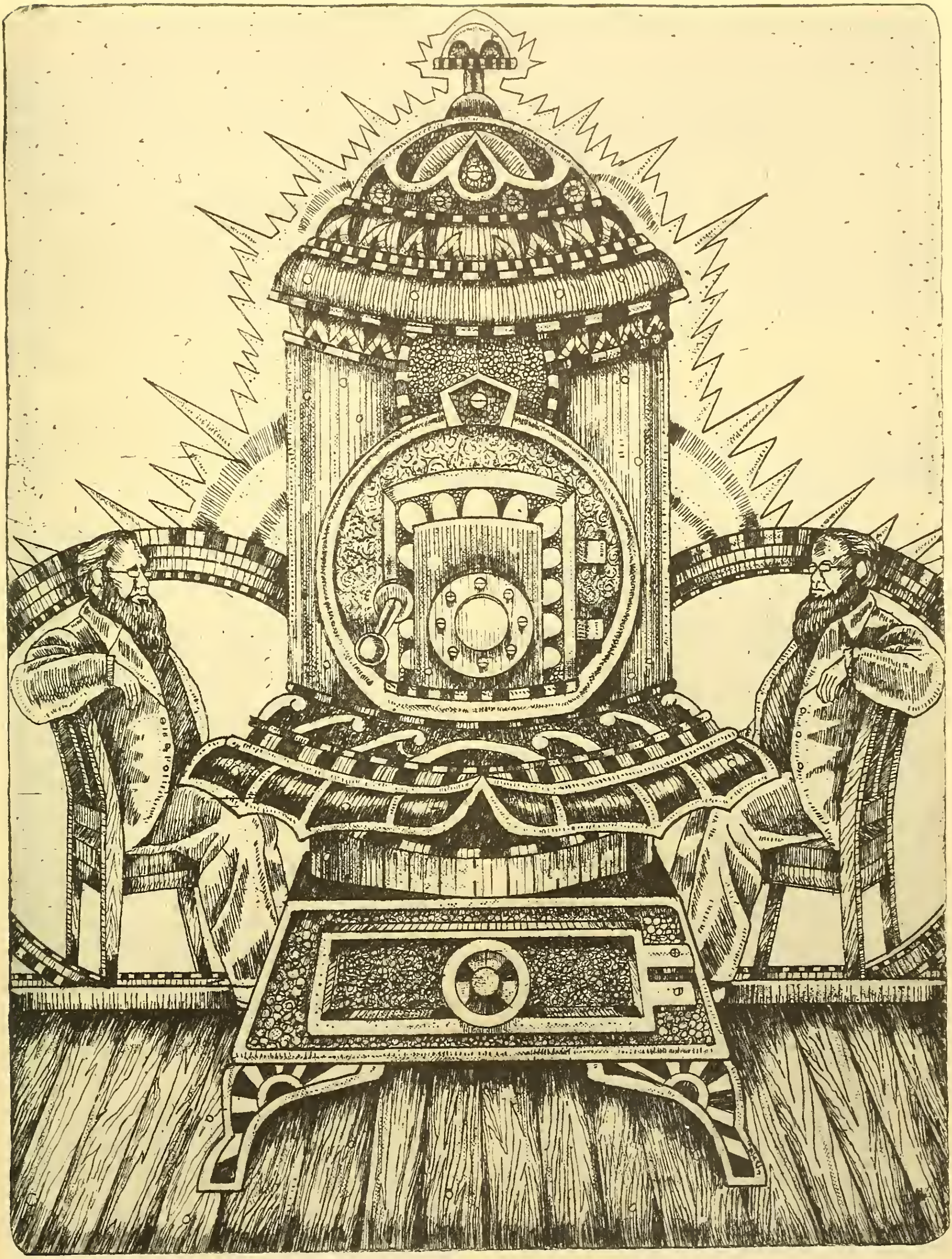
Hard hit by soaring oil costs, U.S. industries also began looking at wood as a possible alternative fuel. As of late 1979, some 150 businesses in New England—from paper producers to horticulturists—had switched from oil to wood. Nationwide, the pulp and paper industry met over half of its energy needs with wood waste in 1980, up from 40 percent in 1972, the last year before the oil price hike.

To the north, the Canadian government in 1978 launched a $150 million, five-year program to encourage industry to burn wood wastes instead of oil or gas. In Finland, where the forest-products industry dominates both the economy and exports, the government is also pressing for the greater use of wood, particularly waste wood, so as to reduce the need for imported oil. In the Brazilian Amazon, U.S. billionaire Daniel Ludwig's vast industrial project at Jari was burning waste wood for heat to run its wood fiber plant and to provide electricity both for the giant industrial complex itself and for Jari's 20,000-member community of workers and their families.

In some tropical countries, fast-growing trees are providing industry with energy. In the Philippines, for example, wood-generated electricity figures prominently in long-term energy plans. Each year from 1981 to 1984, that country's National Electrification Administration plans to invest in 200 megawatts of new wood-fired capacity. The electrical plants will rely on the yield of some 66,000 hectares of land (a hectare is 2.47 acres) planted with fast-

---

This article was adapted from chapter nine, "Renewable Energy: Turning to the Sun," of Building a Sustainable Society, *by Lester R. Brown, a Worldwatch Institute Book, published by W. W. Norton and Co. Copyright © 1981 by Worldwatch Institute.*



growing ipil-ipil, a leguminous tree. The Brazilian steel industry, eleventh largest in the world, now smelts 40 percent of its steel with charcoal. A Japanese steel producer in the Philippines is investing in plantations of ipil-ipil as a source of charcoal for smelting. Other countries such as Uganda use wood to fire cement kilns. And in South Korea a successful tree-planting program during the 1970s had as its prime objective fuelwood production.

In the United States and other industrial countries, the risk associated with the wood revival is that soaring firewood demand could lead to clear-cutting and to progressive deforestation of the sort that has plagued much of the Third World. The challenge is to manage forests on a sustainable-yield basis, thus insuring a lasting supply of wood for fuel purposes, creating local employment, and increasing the forested land's commercial value.

Scores of governments are coming to see forests as among the most efficient means of converting sunlight into usable energy and of supplementing wind and other forms of solar energy that are not available at all times of the day or year. But how rapidly wood's long-term potential as fuel is realized will depend in part on how well forests are managed. Obvious as this may seem, the implied social challenge is immense, given the mounting pressures on local wood supplies. One determinant of wood's long-term contribution as a fuel will be the growth of energy plantations. While more trees are being planted than ever before, worldwide tree-planting efforts are far from being strong enough to satisfy the longer-term growth in demand.

Energy from Waste

With fuel costs over the long term escalating and industrial combustible wastes accumulating, interest in converting waste products into usable energy is gathering force. Organic waste can be converted into useful energy by various processes; the most promising are direct combustion and the conversion of such wastes into alcohol, methane, or other storable fuels.

One of the world's most developed waste-to-energy programs is that for converting urban garbage to electricity. Some twenty years ago, European cities faced with waste-disposal problems began exploring the possibility of burning garbage to produce electricity. The Germans had experience in burning damp fuel, such as lignite or brown coal, and it was relatively easy to adapt the lignite-burning technology to urban waste. As a result, a 1978 survey found that three-fourths of the 262 plants that were converting urban garbage into energy were located in Europe. Most of the remainder were in Japan, while only six were in service in the United States: in Chicago; Franklin, Ohio; Harrisburg, Pennsylvania; Nashville, Tennessee; and Norfolk and Portsmouth, Virginia. (More recently, other plants have begun operating in the United States, and many more are now being planned and built.)

Munich, a model city from this perspective, derives 12 percent of its electricity from garbage and other local wastes. Some of the world's largest refuse-burning plants lie on the outskirts of Paris, where each year they burn 1.7 million tons of the city's garbage in the production of steam. That steam, which both generates electricity and heats buildings, substitutes for an estimated 480,000 barrels of imported oil each year. Not far away, near Rotterdam, the world's largest single waste-burning facility burns more than a million tons of waste annually to fuel a 55-megawatt electrical generating plant.

The extent to which combustible industrial waste products are converted into usable energy varies widely. The forest-products industry has long made extensive use of wood wastes for fuel: in some cases to produce steam for industrial processes; in others, to generate electricity. As oil prices have climbed, the industry has turned more and more to wood wastes. So too the sugar industry has channeled some of its byproducts into energy production. Bagasse, the fibrous residue that remains once sugar is extracted from sugar cane, is commonly used to fuel sugar refineries. And in some countries, including the United States, food-processing companies are beginning to convert such byproducts as cheese whey, citrus wastes, and vegetable-processing wastes into fuel-grade alcohol. By U.S. Department of Energy estimates, it is now economically feasible to convert four-fifths of all such U.S. wastes into alcohol for a net gain of 500 million gallons of ethanol per year, or 0.5 percent of gasoline consumption in 1980.

On the farm, livestock manure and other agricultural wastes represent a potentially huge and self-replenishing source of energy. Cow dung serves as fuel for cooking in deforested parts of the Third World, even as buffalo chips were once used on the American Great Plains for both cooking and heat. More novel technologies for converting livestock manure into methane on a large scale have also been developed within recent decades.

One such process involves fermenting livestock manure in an airtight digester to produce methane, also known as natural gas. Converting livestock manure into methane, rather than burning it directly, yields more energy and also produces a nutrient-rich sludge that can be used as a fertilizer. This double use of livestock manure on a large scale was pioneered in China. As early as 1974, Sichuan Province had 30,000 methane digesters in operation. By the late 1970s, the technology had spread throughout China's other southern provinces, and by 1978 some seven million methane digesters were in use nationwide. Plans, obviously ambitious, called for the completion of twenty million digesters by 1980 and seventy million by 1985.

While the Chinese were acquiring experience with digesters, they also discovered ways of using local organic material other than animal wastes. This is reflected in the various recipes for combining ingredients that go into the digester. One widely used combination for digester loading consists of 10 percent human waste, 30 percent animal waste, 10 percent straw and grass, and 50 percent water.

As oil supplies dwindle, it seems clear that wastes, be they urban, industrial, or agricultural, are going to become important sources of energy. In particular, clean-burning, versatile methane, produced from local materials, can conserve firewood, reduce the need for imported coal and kerosene, and upgrade various vegetable, human, and animal wastes into a high-quality fertilizer. In the process, more environmentally harmful fuels are displaced. Deriving energy from waste is not only a socially attractive proposition, but an economically attractive one as well.

Planting Energy Crops

Born of the liquid-fuel shortage, the concept of planting crops specifically to get energy is relatively new. The concept is simple but not without risks. In a world where food-production pressures on land are already excessive, the planting of energy crops on a large scale will exacerbate the situation. To the extent that energy crops divert land and other agricultural resources from food production, they will surely drive food prices upward. The challenge is to use marginal land or crop byproducts that do not compete directly with food.

Liquid fuels can be derived from vegetable matter either by converting plant starches and sugars into alcohol or by extracting oils from plants that are naturally high in hydrocarbons. Ethanol (ethyl alcohol) has been produced from fruit and grains as an intoxicant for centuries. It can be produced directly from sugar by fermentation or indirectly from starches and cellulose that are first converted to sugar and then fermented. The basic feedstocks for ethanol production are sugar crops (such as sugar cane, sugar beets, and sweet sorghum), root crops (mainly cassava), and cereals.

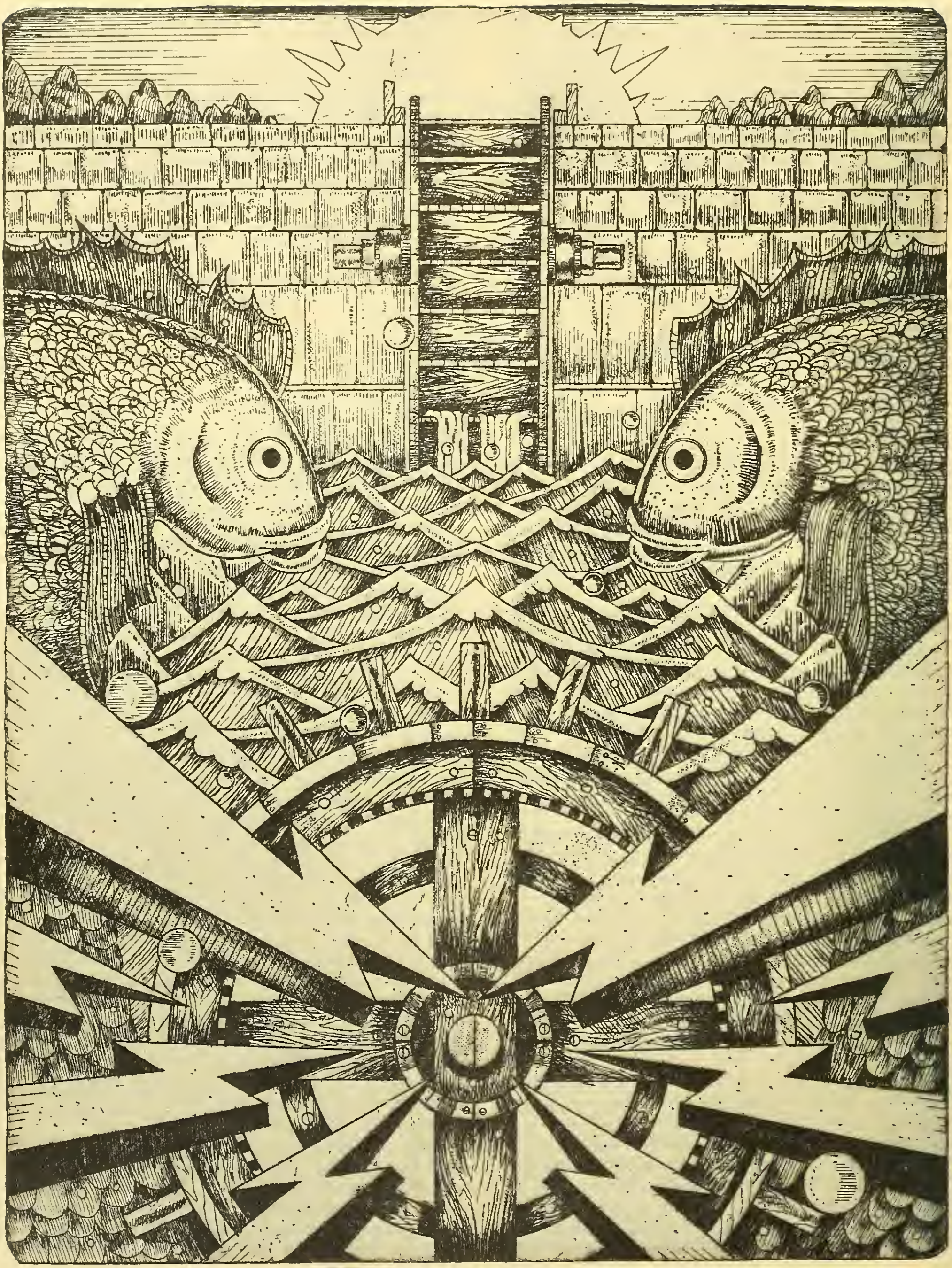
Of all the energy crops, sugar cane produces the highest liquid fuel yield per hectare. Even at the relatively low yields of cane prevailing in Brazil, sugar cane produces 960 gallons of alcohol per hectare, compared with only 580 gallons per hectare from corn in the United States. Second in yield after sugar cane in both countries is sweet sorghum, a commercially neglected crop whose stalks can be crushed to extract the syrup from which alcohol is distilled. Although sweet sorghum is not widely grown in the United States, its potential as an energy crop appears unsurpassed since it can be grown as far north as Minnesota.

Ethanol's potential as a fuel was recognized in Brazil from the early days of the automobile. During the decades that cheap petroleum was available, the production of alcohol fuels was minuscule, being limited to that derived from molasses, a byproduct of sugar manufacture. But by 1975, when Brazil's alcohol-fuel program was launched, the situation had changed and the country's energy goal was to become self-sufficient in automotive fuel—a goal whose importance was reinforced by the Iranian revolution. From 1975 to 1979, alcohol production in Brazil increased fourteenfold. By 1979, alcohol accounted for an estimated 17 percent of Brazil's automotive fuel consumption. Most of this alcohol is blended with gasoline, but in early 1980 new cars with engines designed to run exclusively on alcohol began rolling off assembly lines in Brazil.

In the United States, enthusiasm for alcohol fuel has increased in direct proportion to the rise in gasoline prices. Between March and October of 1979, a period of unprecedented gasoline price hikes, the number of service stations selling gasohol jumped from 500 to over 2,000. The first major boost for the U.S. alcohol-fuels program came with the Energy Act of 1978, which removed the four-cent federal gasoline tax from every gallon of gasohol containing 10 percent alcohol obtained from nonpetroleum sources. In January 1980, the alcohol-fuels program received a second big boost when the White House announced major new production goals of two billion gallons of ethanol per year by 1985—roughly 2 percent of U.S. 1980 consumption of 100 billion gallons of automotive fuel. Meeting this goal would require distilling some twenty million tons of grain, or roughly one-fifth of our exportable surplus.

In Africa, alcohol-fuels production is just taking hold. Alcohol distilleries are converting molasses, a byproduct of local sugar mills, into alcohol in Zimbabwe and Kenya. The Kenyan plant will annually convert 180,000 tons of molasses into ethanol, which will be blended with gasoline in Nairobi. South Africa, the world's leading producer of liquid fuel from coal, also plans to produce alcohol from cassava and sugar cane. It intends to convert the semiarid and sparsely vegetated Makatini Flats in northern Zululand into cassava plantations, erecting thirteen ethanol distilleries that would produce 137 million gallons of liquid fuel annually and create jobs for 2,600 people in cassava production and alcohol distillation. To the extent that cassava can be grown in areas where nothing of agricultural value is now being produced and with resources that would not otherwise be used to produce food, these new "oil fields" will not edge out food crops.

One way to minimize food–fuel competition is to identify undomesticated plants with a high hydrocarbon content that might serve as future fuel sources but that could be



adapted to soils otherwise unfit for agriculture. Melvin Calvin, 1961 Nobel laureate in chemistry and a leader in this effort, believes that cultivating *Euphorbia lathyris*—a hydrocarbon-rich desert shrub found in Mexico and the American Southwest and well adapted to semiarid growing conditions—could yield the equivalent of 6.5 barrels of oil per acre annually. The copaiba tree of the Amazon, another potentially important energy plant, can be tapped like a rubber tree, yielding a liquid that can be used unprocessed in place of diesel fuel. Less esoteric energy crops include sunflowers, soybeans, and African oil palm.

Apart from such land-based energy crops as sunflowers and sugar cane, energy rich water-based plants such as water hyacinths, kelp, and algae also hold promise. Off the coast of Southern California at the Naval Undersea Center of San Diego, giant kelp is being cultivated as a possible source of methane. This project too could eventually point the way to a new source of energy, particularly if an efficient system for mechanically harvesting water hyacinths and giant kelp is developed.

The potential for making methane from water hyacinths, which clog irrigation canals and reservoirs, is being actively studied by the National Aeronautics and Space Administration. One proposal calls for funneling the sewage from urban communities into large lagoons where water hyacinths could utilize the nutrients in the sewage as fertilizer, thus converting an otherwise wasted resource into usable energy. Such a system has an impressive energy-yield potential; one acre of sewage-enriched warm water can produce several tons of water hyacinths each day, enough to yield between 3,500 and 7,000 cubic feet of methane.

At present, projects involving crops suitable for use in alcohol production greatly outnumber those based on plants that yield hydrocarbon extracts that can be used directly as fuel. Eventually, however, both types of plants are likely to find a place in an economic system based on renewable fuels.

Falling Water

For at least 2,000 years, people have been harnessing water to do work. In 85 B.C., the Greek poet Antipater celebrated the development of a water-powered gristmill, noting that it had liberated Greek maidens from the arduous task of grinding grain. Once the basic mechanics of harnessing water power were worked out, the devices spread rapidly, reaching Japan by A.D. 610.

Yet, while water wheels were used throughout the Roman Empire and during the Middle Ages to power mills for grinding flour, sawing wood, and producing textiles, not until the late nineteenth century was water power used to generate electricity. The first central hydrogenerating facility began producing electricity in Appleton, Wisconsin, in 1882. It powered 350 light bulbs and set the stage for the rapid spread of hydroelectric generation throughout the world.

The world's leading generator of electricity from falling water is the United States, which generates 71,000 megawatts per year, followed by the Soviet Union with 47,000 megawatts and Canada with 40,000. Third-World development efforts during the 1950s and 1960s included ambitious hydroelectric projects, such as the Kariba Dam in Zimbabwe (1,300 megawatts), the Aswan High Dam in Egypt (2,100 megawatts), the Furnas Project in Brazil (4,000 megawatts), and the Guri Project in Venezuela (2,900 megawatts).

This impressive growth notwithstanding, the world's hydropower potential is far from being completely realized. Fully developed, it could triple or perhaps even quadruple existing generating capacity. While a few countries such as Japan and Switzerland have little undeveloped hydroelectric potential remaining, most countries are far from this point. Brazil, for example (currently ranked fifth in the world in hydroelectric generation), has developed only 14 percent of its hydropower potential because most of the untapped capacity is located in remote reaches of the Amazon Basin.

Two other countries with vast untapped hydroelectric potential are Nepal and China. Although it has never been thoroughly surveyed, the small mountainous kingdom of Nepal, where several of Asia's rivers—the Kosi, Gandak, and Karnali—originate, is believed to have hydroelectric potential equal to that of the United States and Canada combined. If Nepal, whose 12 million people have an average per capita income of $120 per year, could obtain the engineering capacity and financial resources, it would be able to convert these rivers into a major source of income, marketing the electricity in Pakistan, India, and Bangladesh. In China, the source of two of Asia's largest rivers—the Hwangho (Yellow) and the Chang Jiang (Yangtze)—small-scale hydroelectric projects undertaken locally have sprung up in recent decades, but little progress has been made in harnessing the nation's large-scale hydroelectric resources. As the 1980s began, China was actively exploring with Japan and the United States the potential for developing four dams on the Hwangho and Chang Jiang rivers that would have a combined generating capacity of 32,000 megawatts. Although a capital investment of an estimated $30 billion would be required to pull off this venture, the addition of these dams would more than triple China's existing generating capacity of 14,000 megawatts.

Even front-ranking hydropower producers—the United States and Canada—still have room for significant development. During the 1960s, some far-sighted Quebecois began to see the potential for tapping Quebec's hydropower, both for domestic use and for export to the United States. La Société d'Energie de la Baie James (The James Bay Energy Society) was formed as a subsidiary of Quebec Hydro to develop a 10,300-megawatt hydroelectric project centered on La Grande River. The project has already begun to provide cheap electricity for Quebec and for export, benefiting New Yorkers as well as Canadians. In the past, Quebec Hydro has made electricity available to the New York State Power Authority (for example, some 1,360 megawatts from April through September of 1979). The new project may encourage the expansion of an electrical grid linkage that would serve both countries well since the peak demand in Quebec comes in the winter, while air-conditioned New York City is "summer peaking."

Within the United States, according to the Army Corps of Engineers, the current 71,000 megawatts of generating capacity (including pumped storage) could be raised dramatically if dams that do not have power-generating facilities were equipped with them and if the hydropower output of other dams was increased to full capacity. Undeveloped sites could be exploited to develop some 300,000 megawatts of power, over half of it in Alaska.

In the "bigger is better" world of the postwar era, small-scale hydropower sites have been largely neglected. But rapidly rising costs of nuclear-, oil-, and coal-fired electricity generation in the United States have led to a fresh look at the potential for small-scale hydroelectric projects by government at all levels, private investors, and utility companies. A survey undertaken in 1977 by the Army Corps of Engineers identified more than 50,000 dams—built for water storage, flood control, or recreational purposes—that were not being used to generate electricity. These sites are attractive because the water-impounding structures already exist and require only the installation of electrical generators to tap the energy in the overflow. Small and widely dispersed, such facilities do not require long-distance transmission lines.

France is among the first European countries to inventory the potential for small-scale hydrogeneration. Some 90,000 sites have been identified and, as in the United States, many landowners are beginning to view them as highly profitable investments and long-term sources of income. By some reckonings, small dams—whether in China, the United States, or France—are the oil wells of the future.

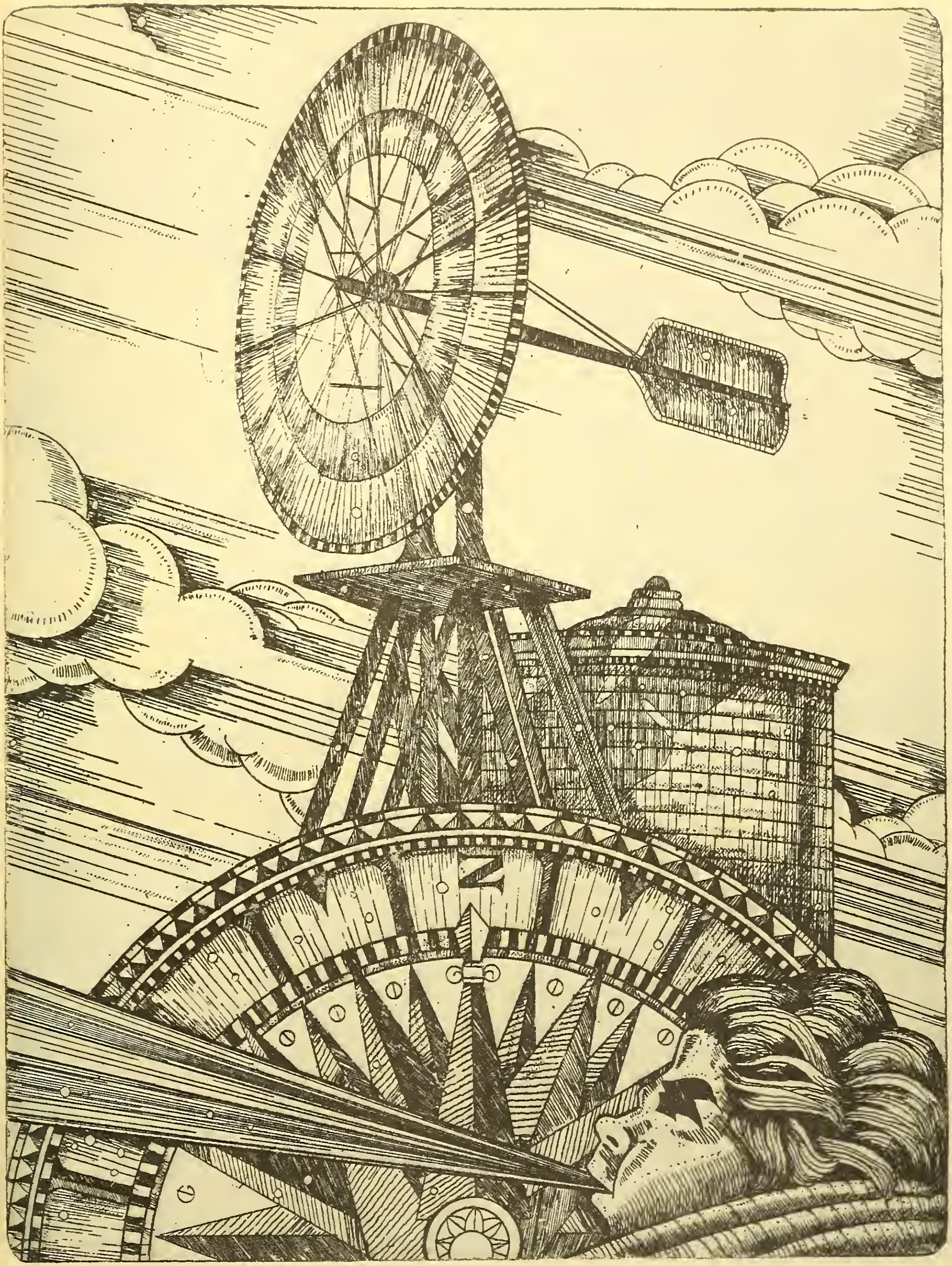
Although the world's hydroelectric capacity has yet to be inventoried in detail, the information at hand suggests that a vast potential awaits development. The obstacles to realizing it are less technological than political or institutional. In some cases, difficult trade-offs will have to be made. Decisions will have to be reached as to whether the loss of cropland or wilderness areas through inundation is defensible in view of the need for a renewable source of electricity. In remote locations, development of hydroelectric sites may await the arrival of energy-intensive industries or further advances in the efficiency of long-distance transmission. But overall, this source of renewable energy may become a cornerstone of a renewable society.

Harnessing the Wind

The first known device for putting the wind to work, a wind-powered water lift, was designed in Persia about 600 B.C. During the twelfth century, windmills appeared in Europe, where they were used to grind grain and pump water. Wind-powered sailing ships were instrumental both in the European colonization of the world during the Age of Exploration and in the growth in international trade that followed.

Embodying an estimated 2 percent of the solar radiation the earth receives, the kinetic energy in the movement of air along the earth's surface is enormous. Much of the economically harnessable wind energy is concentrated along coastlines and in mountain passes. Among the promising coastal sites now being considered for wind generation are the northern coast of the United Kingdom, the southern and western coasts of Australia, the Soviet Union's extensive Arctic coastline, and the Caribbean Third-World countries astride the trade winds belt. The coastal and mountain regions of the United States are also richly endowed with wind power.

The United States, Sweden, and Denmark currently lead the world in the development of wind power. Both Sweden and Denmark, poor in fossil fuels but rich in wind power, are investing heavily in wind research and development. With most of its electricity generated by oil imported from the Middle East and with strong public opposition to nuclear power, Denmark is giving particular attention to harnessing its powerful coastal winds. Both the Danish Academy of Technical Services and the Niels Bohr Institute have published reports exploring the various components of a national wind-power strategy. Several small-scale wind generators have been built and connected to the national electricity grid. Perhaps the single most innovative Danish effort has been the design and construction of a wind generator by a group of professors and students at the Tvind Schools—a high school, teacher's training college, and vocational school for teen-agers, located near the village of Ulfborg, some six miles from the North Sea coast. Between 1975 and 1978 this group, supported by advisers from the Technical University in Copenhagen and elsewhere, built the world's largest wind generator for a modest investment of $900,000. The



"Tvind" stands as a remarkable example of what local initiative can do in developing alternative energy sources.

Like Denmark, Sweden is naturally endowed with a belt of strong westerly winds. Since 1975, the Swedish government has committed substantial resources to wind-generator design, to the construction of experimental models, and to "wind prospecting," or finding areas with high wind-energy potential. Swedish scientists have outlined an ambitious plan that calls for the construction of some 3,300 large wind generators capable of generating as much electricity as seven large nuclear reactors. Many will be integrated with pumped-storage systems at existing hydro reservoirs to stabilize the flow of electricity.

Although many countries are now seriously exploring wind power, the United States is at the leading edge. Between 1973 and 1980, the Department of Energy (DOE) spent nearly $200 million studying and developing wind turbine generators. Most of that sum went into the development of large- and middle-sized turbines, but roughly a quarter of the budget underwrote the development of generators of the two- to ten-kilowatt variety—machines small enough for use by individual homeowners, farmers, and ranchers.

DOE's early wind-generator prototypes, erected at a variety of sites around the country, were medium-sized machines designed to produce a flow of 200 kilowatts. The second generation of wind turbines is much larger, mostly in the 2.0 to 2.5 megawatt range, a size that some engineers believe will be economically optimal. The next step in the DOE program was to construct three 2.5-megawatt wind turbines in Washington State near the border it shares with Oregon. Each of the propeller blades of these Boeing-built prototypes spans over 300 feet—more than the wingspan of a Boeing 747 jumbo jet. The machines will stand in a windy gorge of the Columbia River and feed electricity into Bonneville Power, the local utility. At full power, this cluster of three wind turbines will provide enough electricity for 2,500 average American homes. (Four hundred such machines could produce as much power as a large nuclear- or coal-fired generating plant.)

In tandem with the rising cost of power generated from nuclear- and coal-fired plants, the declining cost of wind-generated electrical power is spurring the formation of new firms to exploit this promising new market. Sensing this new potential, Congress passed the Wind Energy Research, Demonstration, and Utilization Act of 1980, a bill that would provide strong market support for wind generators through 1985, by which time the industry should be mass producing wind generators. Support for the bill stemmed from the conviction that wind could supply 2 to 4 percent of national electrical power demand in the year 2000. It now seems likely, however, that the ambitious timetable for wind energy development embodied in the Wind Energy Act will be altered by the budget cuts of the Reagan Administration.

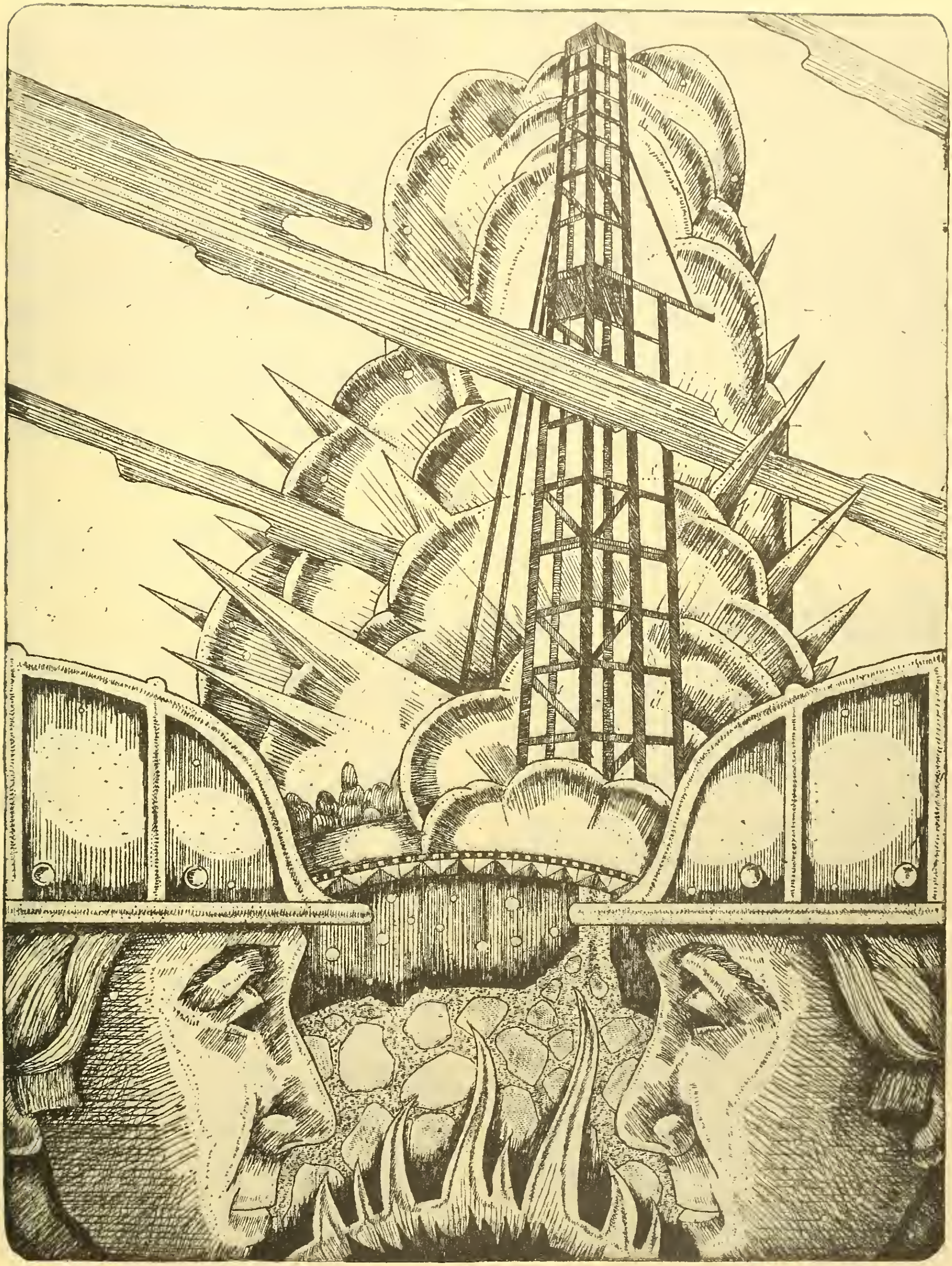
Geothermal: Tapping the Earth's Heat

Hot springs, geysers, and the molten rock that pours from erupting volcanoes all testify to the great heat within the earth. But only recently have scientists begun to assess the possibility of utilizing the earth's geothermal resources. Derived from neither solar nor fossil sources, the geothermal heat generated by radioactive processes in the earth's interior and stored under the earth's cool outer crust is so vast relative to human needs that it is for all practical purposes a renewable resource. While a complete inventory of global geothermal potential is years away, the world's principal geothermal belts are well known as a result of volcanic activity and available geologic information.

The frequent volcanic activity around the Pacific rim makes geothermal energy both a highly visible and widely dispersed energy source. Geothermal energy can be readily tapped wherever the earth's crust is thin. The earth's richest geothermal resources are in the so-called ring of fire that stretches from New Zealand up through New Guinea, the Philippines, Japan, western Siberia, and then down the western United States, Mexico, Central America, and the west coast of South America.

Geothermal heat can be used either directly for residential heating, industrial processes, and greenhouses or indirectly to generate electricity. The form adapted depends on the resource's ultimate use and its temperature at the source. But since geothermal energy is site-specific and cannot be readily transported except in the form of electricity, industries utilizing it are likely, over time, to converge on the world's major geothermal fields, much as they are beginning to concentrate in areas rich in hydroelectric power and in forests.

Several countries use geothermal energy for space heating in confined areas. For example, Iceland has long relied on geothermal energy for residential heating. Sixty-five percent of all Icelandic homes are heated by hot water drawn from underground, and most of Iceland's fresh tomatoes, lettuce, and cucumbers are produced in geothermally heated greenhouses. Two U.S. cities—Klamath Falls, Oregon, and Boise, Idaho—also rely heavily on geothermal heating. Hungary and the Soviet Union both have extensive acreages of geothermally heated greenhouses.



Direct industrial applications of geothermal heat are just beginning to be developed. One of the first industrial firms to use it was the Tasman Pulp and Paper Company in Kawerau, New Zealand, starting in the early 1950s. Tasman used geothermal heat to operate its pulp and paper plant and timber-drying kilns. In Iceland, one of the world's largest facilities for processing high-grade diatomaceous earth (earth abounding in diatoms or their siliceous remains) relies entirely on geothermal heat, most of it averaging 480°F at the wellhead.

Although geothermal heat is used directly in many locations, its greatest long-term potential is in the generation of electricity. Geothermal electricity is still in the early stages of development, but it is growing by leaps and bounds. Among the early developmental leaders are the United States, Italy, New Zealand, and Japan. Total capacity at the beginning of 1979 was 1,500 megawatts, the equivalent of roughly one and one-half of the largest coal- or nuclear-powered generating plants. Within the United States alone, the 500 megawatts of capacity on line in 1979 is expected to reach 1,800 megawatts by 1983. By that time, 3 percent of the electricity in the states with geothermal-powered plants —California, Utah, Nevada, Hawaii, and New Mexico—will be geothermally produced. By the end of the century, California could be drawing 25 percent of its electricity from geothermal sources and oil-short Japan may emerge as the world leader, with as much as 48,000 megawatts of geothermal-electrical capacity. The United States may be second with 27,000 megawatts of installed capacity.

Perhaps the most ambitious single geothermal power plant currently under consideration is one in the Soviet Union. A 1980 study sponsored by the U.S. Department of Energy reports that "plans are under way to tap the Avashinski volcano on the Kamchatka peninsula at a depth of 3.5 km (11,500 feet) in the hope of establishing a resource which might supply a 5,000-megawatt geothermal plant for 500 years."

Largely ignored during the era of cheap oil, geothermal energy development now looks relatively cheap and environmentally benign. By the end of the century, geothermal heat promises to be the dominant energy of electricity generation in several countries and a major entry in the global energy budget.

Rooftops as Collectors

The technology for collecting solar energy for heating purposes is one of the simplest processes imaginable. In essence, it consists of a glass-topped box with a dark bottom, which absorbs incoming sunlight. The box traps the heat of the sunlight in the manner of a greenhouse. The glass permits unimpeded light to stream in but checks the outflow of heat.

A slightly more complex variation of this technology is the vacuum tube collector, now widely marketed in the United States. In this collector, a glass tube an inch or so in diameter and containing water or some other heat-absorbing liquid is situated inside a somewhat larger glass tube. The space between the two tubes—a partial vacuum—serves as an insulator, trapping the heat in the inner tube. Low-grade, or low-temperature, heat, is what collectors produce. Once the heat is trapped in either type of solar collector, it can be used to heat water or interior space or as low-grade heat for industrial processes.

One salient advantage of solar collectors is their self-sufficiency. They can provide household energy without being hooked up to the grids through which electricity, natural gas, and other forms of energy are distributed. Another advantage is size. Since collectors can be fitted on rooftops, their land requirements are minimal. A third selling point is their invulnerability to politically inspired fuel embargoes or other international disruptions such as those associated with oil or uranium economies.

Despite their simplicity and these other advantages, rooftop collectors have not yet become standard household features in most of the world. The availability of cheap oil and natural gas all but deadened interest in them for almost two decades. But one country that relied in part on solar energy when other nations developed petroleum-based economies was Israel. Roughly one-tenth of all Israeli households today use solar energy for heating water, and the Israeli government expects that between 1980 and 1990 the number of solar heating units will increase from 400,000 to 650,000. Underpinning this growth are the requirement that all new public buildings incorporate solar water-heating systems and the Ministry of Energy's commitment to covering 10 percent of the costs of all new solar installations.

In the United States, as in most other countries, interest in solar collectors surged following the OPEC oil price increase in late 1973. Although sales from the fledgling industry totaled only 1.3 million square feet of collectors in 1974, sales exceeded an estimated 19 million square feet annually by 1980, bringing the cumulative installed area of collectors up to nearly 67 million square feet, or one square foot for every three people in the United States.

The potential for solar collectors must be gauged in terms of the need for low-grade heat. They can be used to supply heat for farm grain dryers, car washes, restaurants, and food processing. In the United States, where some 33 percent of all energy is used for heating purposes, the solar potential is therefore commensurately large. As the phased decontrol of U.S. oil and natural gas prices nears completion, the employment of solar collectors is likely to be increasingly appreciated. An added inducement is being provided by tax credits at both the federal and state levels. The Energy Tax Act of 1978, as amended by the Windfall Profits Act of 1980, provides through 1985 a 40 percent credit toward the first $10,000 spent on active solar equipment designed to heat water or to heat or cool a home. Supplementary financial incentives, mostly in the form of tax credits, are also available in most states. California, for example, provides a tax credit of 55 percent, up to a maximum of $3,000, toward the cost of residential solar installations. In some cases the two types of credits are cumulative, so the consumer actually pays less than half the up-front costs of the system.

In France, which imports all of its oil and most of its coal, interest in solar collectors runs high. While only 20,000 solar hot-water heaters were in use in 1979, France hopes to be manufacturing a half million solar water heaters per year by 1985. Low-interest loans that completely cover the cost of solar collectors and their installation are expected to undergird the expanding market.

Among Asian countries, Japan is indeed the Land of the Rising Sun. As of 1980, over 1.6 million buildings were using solar heating systems, the great majority for heating water. By 1985, the Japanese government expects that some 4.2 million buildings—homes, factories, and offices—will be similarly equipped. The plan is to increase this to 7.8 million buildings by 1990 and to 12 million by 1995. By the latter date, 30 percent of all buildings are expected to have solar collectors on their rooftops.

As the 1980s began, rooftop solar collectors contributed only marginally to the world's energy supply. But the stage was set for rapid expansion. In the United States, some 360 firms were manufacturing and marketing solar collectors in 1980. As fossil-fuel supplies dwindle, energy prices rise, and the costs of solar collectors fall with mass production, these devices can be expected to meet a steadily expanding share of the world's need for low-temperature heat.

Electricity from Sunlight

Electricity can be generated from sunlight in two ways. One way is by concentrating sunlight on water to generate steam, which is then used to drive an electrical generator as in fossil- or nuclear-fired electrical generating plants. This technology, however, does not appear to be cost effective and is unlikely to go beyond the pilot plant stage. The second method depends on the photovoltaic cell.

In 1954, scientists in New Jersey's Bell Laboratories discovered that a silicon wafer could generate an electrical current when struck by sunlight. When a light photon hits an atom of silicon with enough impact to dislodge an electron, a diffuse form of electricity is generated. In the photovoltaic cell, the energy that dislodges the electron is funneled into a wire leading from the cell. The direct current (DC) generated in this way can then be converted either to alternating current (AC) or can be used more efficiently directly with DC-compatible appliances.

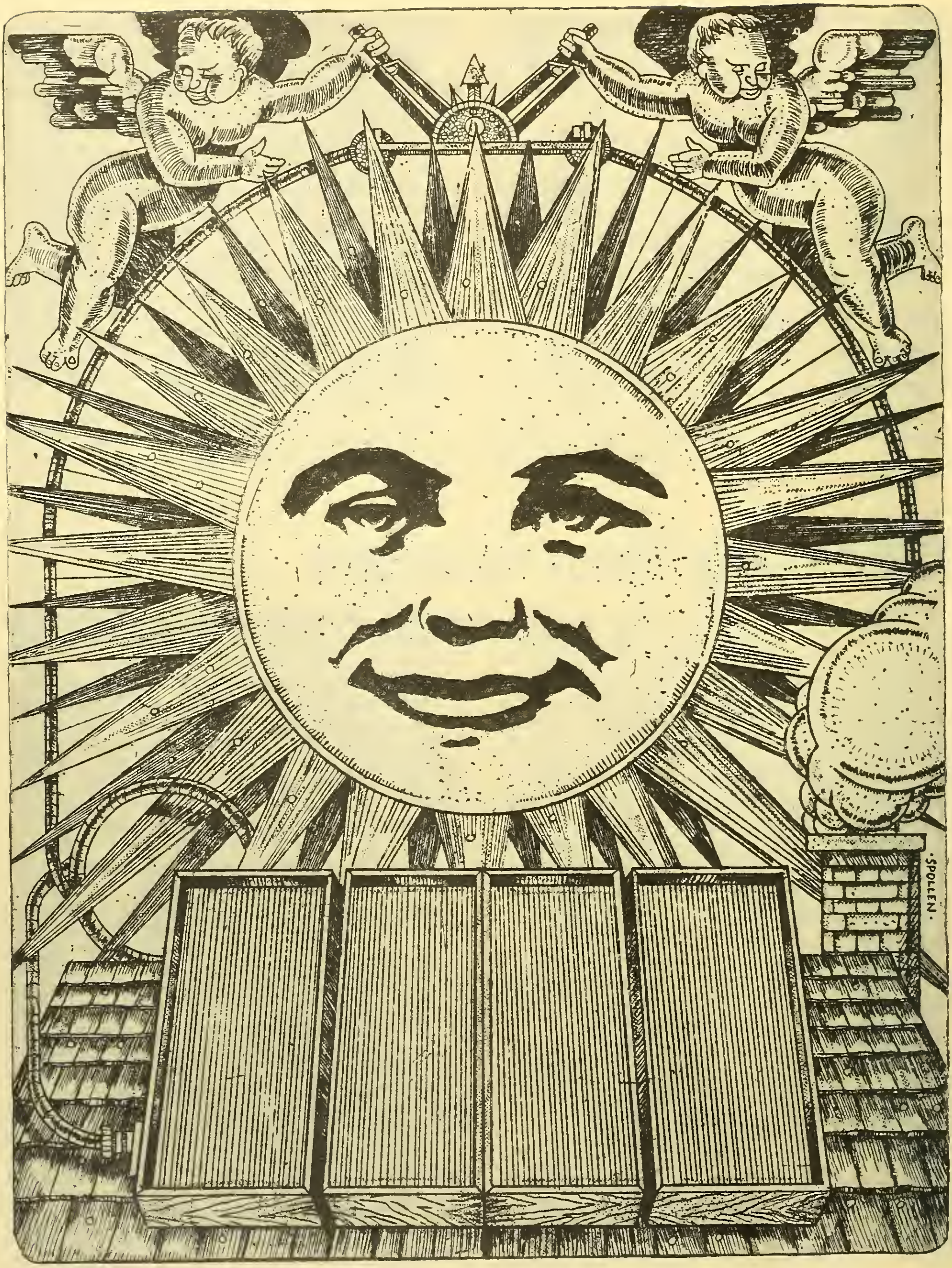
Photovoltaic cells are thin wafers of varying shapes and sizes. Single cells for use in pocket calculators are often less than one-half inch square. Cells can also be linked together in arrays that are large enough to cover a rooftop.

Despite the photovoltaic cell's latecomer status, the feasibility of the technology for special uses is no longer questioned. By the mid-1960s, photovoltaic cells were being used to power communications satellites. At issue is whether the cost of photovoltaic-generated electricity, which is falling rapidly, will fall far enough to make it broadly competitive. Photovoltaic cells installed in the orbiting Skylab launched in 1973 cost $300 per peak-watt. In 1976 a small-scale purchase of the cells by a railway cost $45 per peak-watt of power. In 1978, one large government purchase was made at $11 per peak-watt, another at $7 per peak-watt. The Department of Energy projects that the price will fall to $2 per peak-watt by 1982, to 50 cents by 1986, and to 10 to 30 cents in the 1990s.

The big market for photovoltaic cells may turn out to be in the hundreds of thousands of villages in the Third World that have not yet been electrified. Although it now costs more to install photovoltaic generating capacity than conventional electrical generating capacity, the grid needed to distribute conventionally derived energy can be far more costly than the generating capacity itself. For that reason, and because photovoltaic arrays need not be large to be efficient, photovoltaic devices may already be cost effective for villages that have modest electrical needs and no connection with a utility transmission grid.

The world's first solar-electric village is in a U.S. setting with a Third-World character. In December of 1978, Schuchuli, one of fifty-three villages on the Papago Indian Reservation in southwestern Arizona, was electrified for the first time when its photovoltaic array was turned on. When the switch was thrown in this remote, sun-drenched community of only ninety-six inhabitants, it illuminated fluorescent lamps that replaced kerosene lamps and started a small water pump that replaced a diesel-powered pump. The photovoltaic panels in Schuchuli now produce 3.5 kilowatts of peak-watt power—enough for forty-seven fluorescent lights, a two-horsepower water pump, fifteen small refrigerators, a sewing machine, and a communal washing machine. Excess power is stored in batteries for use at night and on cloudy days.

The world's second solar-electric village is in Upper Volta in western Africa. There, the U.S. Agency for International Development has sponsored a 1.8-kilowatt


SPOLLEN

photovoltaic generating array, which produces power that villagers use to pump water and grind grain. The water pump lifts 1,320 gallons per day, the most the well can supply, while the gristmill produces enough finely ground grain to meet the requirements of about 640 families. In this village of 2,700, where farming and cattle raising are the main activities, the new power source is particularly appreciated by the women, who have traditionally spent long hours drawing water and grinding grain by hand.

Heartening as early photovoltaic applications may appear, it is difficult to say exactly how rapidly use of this energy technology will grow given the uncertain pace of technological advance. Yet as the 1980s began, the photovoltaic industry in the United States was gathering force, and activities once sponsored and funded solely by government were being taken up by private enterprise. If production costs fall as projected, electricity from photovoltaic cells could become particularly important to that segment of humanity living in the hundreds of thousands of villages not yet connected to power grids.

Solar Architecture

Solar architecture was an advanced profession 2,500 years ago when the ancient Greeks practiced its principles. The archeological remains of other ancient civilizations in North Africa, the Middle East, northern India, and the southwestern United States also indicate that the principles of solar architecture were fully mastered millennia ago. Before the potential of fossil fuels was known, much less the utility of electricity, buildings had to be made warm in winter and cool in summer. Now that fossil-fuel reserves are being depleted, modern civilization is rediscovering the value of solar architecture—the design of structures with minimal fuel requirements for heating and cooling.

Passive solar design, described by one enthusiast as an energy system that has only one moving part—the sun—begins with site selection. Any given building site accentuates some local climatic features while minimizing the effect of others. Locating a house on or near a hilltop will usually mean more wind exposure—a spur to both summertime ventilation and wintertime heat loss. Although some sites actually afford good air movement during the summer without excessive exposure to winter winds, most locations entail a combination of costs and benefits, all of which need to be carefully calculated.

Building orientation can increase or decrease fuel bills by a third. In the north temperate zone, buildings should face south in order to take advantage of the wintertime sun low in the southern sky. Incorporating a roof overhang insures that the southern side of the house will be shaded from the hot midday sun during the summer, while minimizing the amount of glass used on the northern side restricts heat loss. Locating living spaces on the southern side of the home, while placing closets, baths, storage rooms, entryways, and garages on the north side, also saves energy and reduces drafts. By the same token, a two-story house loses less heat than a sprawling one-story house with the same floor space. Town houses, row houses, or other structures that share common walls also lose less heat to the outdoors than free-standing buildings do.

Insulation obviously plays an important role in conserving energy. A poorly insulated house that acquires one-fifth of its wintertime heat from the sun could acquire half if carefully insulated. For this reason, keeping the amount of such poor insulators as glass to a minimum on all but the south-facing walls is also critical. Doing so helps minimize the heat loss in wintertime and the cooling costs when air conditioning is needed. Indeed, some new glass-walled office buildings have turned out to be extraordinarily costly to cool in the summertime since they function as giant solar collectors. As the future of energy prices remains uncertain, the cost of cooling buildings of this design could become prohibitive, while insulation may become more and more economical.

The above-mentioned considerations and other design features enable modern architects to better even the ancient Greeks, who designed buildings that provided two-thirds of the daytime heat they needed during winter. Advances in engineering, wider understanding of thermodynamics, and the availability of new building materials all spell exciting new possibilities in passive solar design. At the University of Saskatchewan in Canada, for instance, the Mechanical Engineering Department faculty has designed a house so energy efficient that it does not pay to install a furnace. Homes built on the Saskatchewan model remain comfortable in the Canadian prairie's interminable subzero winter. What is more, they resemble conventional homes in the area in both appearance and price and cost their residents only about $40 annually to heat.

The heating requirements of these carefully designed homes are so low that 85 percent of the needed heat comes from the occupants' bodies, the operation of electrical appliances, and from windows on the southern exterior. This extraordinary thermal efficiency is due to several ingenious design features: double-studded walls that contain twelve to fifteen inches of fiberglass or cellulose insulation; wrapping the whole building (except for windows and doors) in a "bag" of polyethylene plastic installed in the walls; and double- or triple-glazed windows (seven out of nine of which are on the south side) that are covered with heavy shutters at night. Houses as tightly built as these, however, need an air exchanger to introduce fresh air from the outside and to get rid of stagnant air once its heat has been captured for reuse. A heat-recuperator system can also help to transfer the heat from hot water already used for bathing, dishwashing, and laundry to unused fresh water that needs to be heated.

Needless to say, the economic appeal of such a home in the severe climate of Saskatchewan is strong. While the extra insulation, window shutters, and heat exchangers represent additional costs, the expenses can be recouped because no furnace is needed.

Office buildings also can be built so as to sharply reduce commercial energy use. The Tennessee Valley Authority is planning to construct a new five-story, energy-efficient office building in Chattanooga, Tennessee, to house some 5,000 of its employees. The transparent roof of this spacious office building will permit large amounts of sunlight to enter during the wintertime. When combined with tight insulation and additional sources of heat from bodies, office machines, and lights, the building will require relatively little additional energy for heating purposes. In the summertime, the roof will be shaded with louvers, and the building's air-conditioning system will rely on cold water from an aquifer beneath the building.

The private homes in Saskatchewan and the office building in Chattanooga are but two of many examples of how architectural ingenuity can substitute for the use of purchased energy. Both demonstrate dramatically the feasibility of substituting modern technologies for dwindling fossil fuels and the need for new building codes that emphasize standards and performance rather than specific structural requirements.

The Renewable Energy Potential

Wood and hydroelectric power, currently the world's leading sources of renewable energy, rank fourth and fifth in the global energy budget after oil, coal, and natural gas. Yet despite their importance in the global energy budget, many sources of renewable energy are frequently omitted from projections of world energy use because data on their abundance and availability are not available.

At present, renewable energy sources are estimated collectively to supply the energy equivalent of 1.81 billion tons of coal—or some 16 percent of the global energy budget. Between 1980 and the year 2000 the use of renewable energy is expected to more than double. Interest in renewable energy sources is being spurred by the impact of rising oil prices and other economic considerations. First, since renewable energy resources are largely indigenous, they often make outlays of foreign exchange either nonexistent or negligible, limiting the expenditures to imported equipment or technical advice. Second, many renewable energy sources are virtually inflation proof. Once a hydroelectric dam is constructed, the cost of generating electricity remains quite stable. Similarly, a homeowner who installs a solar water heater is immune to rising utility bills for heating water.

In employment terms, too, renewable energy sources are attractive. They invariably require less capital and create more jobs than do fossil fuels or nuclear power. In this respect, the timing of the global transition from fossil fuels to renewable energy could not be more fortuitous, coming as it does when unemployment is high in industrial and developing countries alike and when record numbers of young people are entering the job market.

Another advantage is that time lags in the development of renewable energy resources are shorter than for most other energy sources. A decision to turn to wood in a heavily forested area takes no more time than that required to purchase a wood stove or, in the case of industry, a wood-fired boiler. A methane generator can be built in a matter of days. A small-scale hydropower facility can be constructed with seasonally unemployed labor in a few months. Exceptions to this short lead time include large-scale hydroelectric projects, which can take many years to complete, and firewood plantations, which can require close to a decade before harvesting can begin. But overall, renewable resources can be developed extraordinarily rapidly, as shown by the present use of wood fuel in the United States, geothermal energy in the Philippines, and energy crops in Brazil.

In some cases, the technologies required to develop renewable energy resources are closely related to existing, well-understood technologies. For example, the engineering and aerodynamics of wind generators are close to those employed in the aerospace industry. Similarly, the knowledge of deep drilling and geology brought to oil exploration and production can be easily modified for geothermal development. Indeed, oil companies frequently discover geothermal resources when drilling for oil.

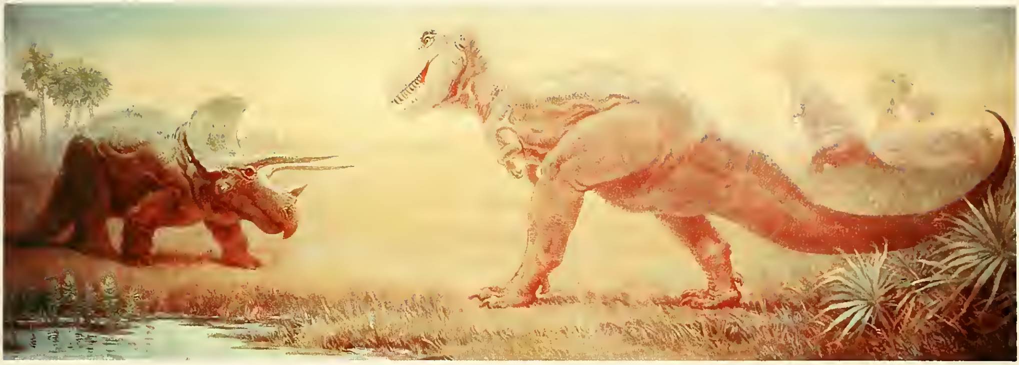
Of the several renewable energy technologies, the one whose future depends most heavily on further technological advances is photovoltaics. Unless the manufacturing costs of photovoltaic cells are substantially reduced, their use will be limited to special situations, mostly remote places where no alternative electrical sources exist. But if the costs can be brought down to the levels envisaged by the U.S. Department of Energy in its photovoltaic program (50¢ per peak-watt), then these cells will have a promising future.

Of course, realizing to the fullest the total renewable energy potential will mean that difficult trade-offs will have to be made. But even so, the untapped capacity of "renewables" holds promise. In many cases, an upsurge in their growth may outstrip projections, and the return to renewable sources may provide a security of energy supply unknown in the latter stages of the petroleum era. ☐

Giving Life to Ancient Bones

An American artist gave the world its visual concept of prehistoric life

by Sylvia Massey Czerkas and Donald F. Glut



Triceratops and tyrannosaurus

Field Museum of Natural History

Charles Robert Knight was the first and undeniably the foremost artist to re-create, with both scientific accuracy and romantic beauty, creatures and environments of the prehistoric past. For nearly half a century, Knight gave to a modern world his visions of its prehistory, producing roughly one thousand drawings, paintings, and sculptures of ancient animals and humans. His were the first truly modern visual conceptions of the creatures that once inhabited this planet, and his depictions of them have never—even decades after he created his final piece of art—been surpassed.

Knight was born in Brooklyn in 1874, to Lucy and George Wakefield Knight. George Knight was then employed as the personal secretary to banker John Pierpont Morgan, who would later play an important role in Charles's career at the American Museum of Natural History. From his early childhood on, Knight's parents instilled in their young son an interest in, and love of, nature.

Charles was only five years old when his father first took him to the American Museum, but even at that age he was aware that there could be an artistic approach to presenting animal life to the public and had already discovered in himself an intense interest in drawing.

After the death of Knight's mother, his father married Sarah Davis, a woman with artistic abilities who recognized her stepson's talents. She sent him to the Froebel Academy, and there he began his formal art education, taking classes in drawing, mapmaking, and clay and sand modeling, in addition to more mundane subjects. Knight later enrolled at the Metropolitan Art School, where most of the students were older than himself. These more experienced students taught the young artist that he could earn money for his artwork. Knight, who was also attending classes at the Art Students League, became skilled in watercolor, pencil, charcoal, crayon, and oil, and utilized those skills when, at age sixteen, he began his professional career.

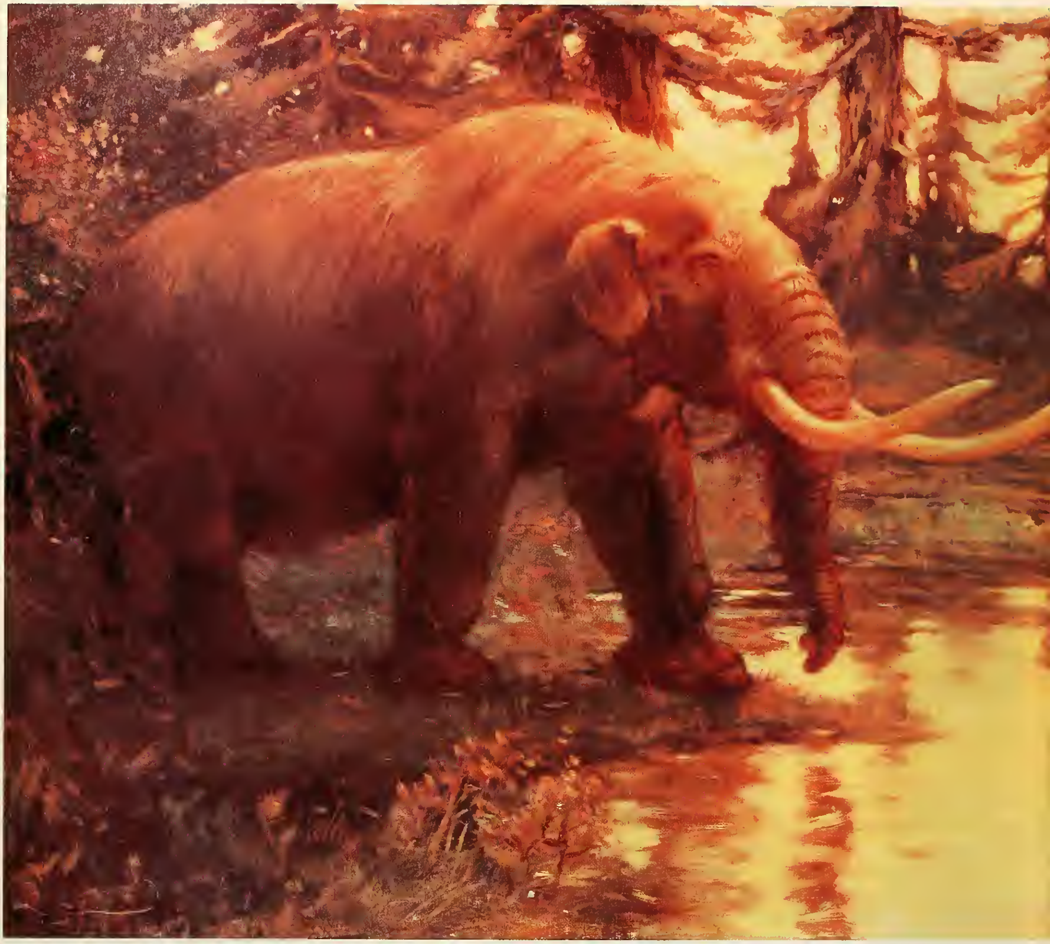
Knight was hired by a church decorating firm to draw animals and plants for stained-glass windows. While working at this job, he spent much of his free time at the zoo in Central Park drawing animals from life. When he finally carried his personal studies over to the American Museum of Natural History, he already had a full mastery of his artistic materials. Visiting the Museum almost daily, he studied the carcasses of various creatures, familiarizing himself with their musculature and skeletal structure. In the taxidermy department he carefully examined eyes, paws, noses, and ears, and drew detailed close-ups of what he saw. Often the carcasses were foul smelling, but he was learning from this firsthand course in animal anatomy. No dead tiger, kangaroo, pelican, or macaw passed through his hands without being re-created on paper. What he learned in that department about muscle and bone, and what he had already learned through experience about animal psychology, helped lay the foundation for the next phase of his career.

Knight's name soon became known to the scientists at the Museum. As an

---

Adapted from *Dinosaurs, Mammoths, and Cavemen: The Art of Charles R. Knight*, by Sylvia Massey Czerkas and Donald F. Glut, by permission of the publisher, E.P. Dutton. All rights reserved under International and Pan-American Copyright Conventions.

AMNH



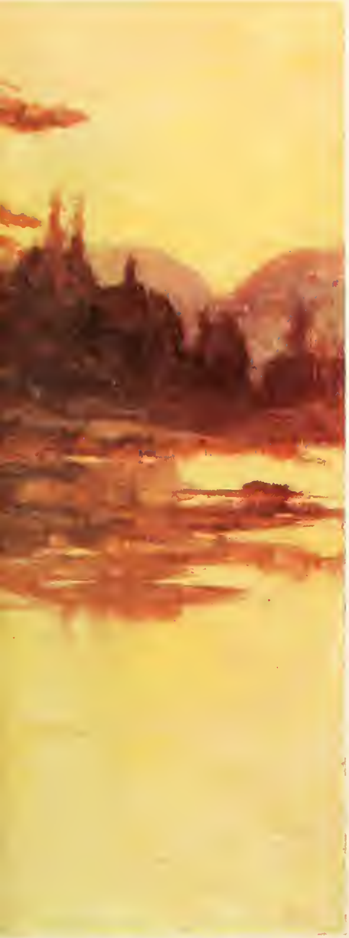
amateur scientist always anxious to learn more about the animals that he drew, Knight soon met many of the staff scientists who, impressed by his desire to learn, offered him continued advice and encouragement. One of Knight's closest friends at the Museum was head taxidermist John Rowley. One day in 1894, Rowley told Knight that Dr. Jacob Wortman, in the fossil department, was looking for someone to make a drawing of a prehistoric animal.

At Rowley's suggestion, Knight went upstairs to offer his services. Wortman, a specialist in fossil teeth, wanted him to create a life restoration, that is, a drawing that would depict the animal as it might have looked when living, of an extinct piglike mammal called *Elotherium*. Knowing something about modern-day pigs, Knight studied the skeletal remains of *Elotherium*, applied to those ancient bones his educated estimate as to its musculature and attitudes, then made a restoration that both satisfied and delighted Wortman. Soon Wortman was giving Knight more assignments, inadvertently directing him into a field of work that would occupy much of his time for the next four decades.

In 1896, Knight made one of the most important contacts of his life, Henry Fairfield Osborn. Osborn, a distinguished scientist who had just taken a position at the American Museum, later founded the Department of Vertebrate Paleontology. When Osborn first came to the Museum, its fossil collection was meager and much of it existed on shelves in the workshops, seen only by workers who cared little about the interests of the general public. But, in addition to being a scientist, Osborn had a keen taste for artistic beauty. "Prof. Osborn was something of a naturalist and an artist at heart," Knight later wrote, "and had a great appreciation of all things living and beautiful."

Osborn promptly recognized Knight's talents and took the young artist under his wing. He revealed to Knight his dream of luring the layman into the Museum's halls by making the paleontological exhibits both visually informative and exciting. Of course, Knight would become a prime force in Osborn's master plan.

About this time Knight also met William Matthew, a Canadian scientist who had recently joined the Museum staff. In later years, Knight wrote that Matthew "for years was my chief consultant and adviser on matters of pose and diffi-

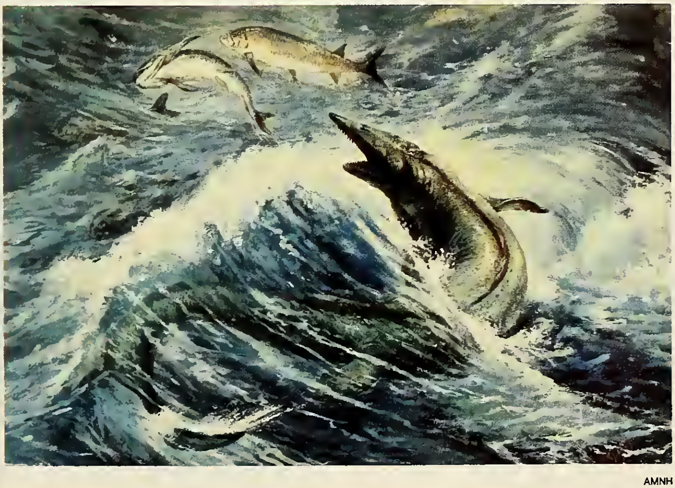


cult bone structure, and what unusual forms might indicate in the living animal." Like Knight, Matthew soon shared Osborn's dream.

Osborn arranged for the Museum to acquire more fossil vertebrate specimens, and the galleries that were to house the new exhibits resounded with the noises of the preparators' scrapers, mallets, and drills. The trio of Osborn, Knight, and Matthew endeavored to have the fossil skeletons mounted in lifelike poses, a revolutionary concept for the period. One staff member, chief preparator Adolph Hermann, thought that fossil specimens were for study and not for the edification of the public. Hermann, whose idea of mounting a skeleton was simply to string the vertebral column along a straight length of steel rod, was, not surprisingly, opposed to the new ideas of the Osborn-Knight-Matthew team. But he soon acquiesced, as did others at museums around the world, which began to imitate the new techniques. Knight, of course, was also to provide the paintings of the animals in life that would grace the American Museum's paleontology galleries.

To achieve the remarkable realism displayed even in his earliest prehistoric restorations, Knight first studied the bones of the extinct creature. His goal was not simply to restore an animal never seen by modern man but to infuse it with life. Therefore, he applied the knowledge he had garnered from studying living animals, his philosophy being that no one can paint an animal that is "dead" before being able to paint one that is alive. Then, after questioning Osborn or Matthew about the possible appearance and habits of the creature, he extrapolated what he knew of present-day animal physiology and psychology and gave life to the ancient bones.

At left, mastodon; below, mosasaur, or great marine lizard



AMNH

Once he had a fairly accurate conception of the extinct creature in his mind, he would make a miniature sculpture of the animal so that he could take it out into the sunlight and note the shadows it cast on the ground. Sculpting was relatively new to the artist, who mastered the technique so that he would have a three-dimensional model from which to make his painting. This step in his restoration process worked for Knight, and his command of the sculpting medium would soon lead him along other avenues of artistic pursuit.

Life restorations of prehistoric animals were rarities in 1896, most paleontologists being content to study disarticulated fossil bones rather than see some hypothetical re-creation of the animal in the flesh. But Osborn was, through Knight's skills, doing his best to change such thinking. That year, *Century Magazine* published an article by Osborn, "Prehistoric Quadrupeds of the Rockies," which was illustrated with nine spectacular paintings by Knight of extinct mammals.

That article brought Knight's work to the attention of Osborn's mentor, Edward Drinker Cope, one of the pioneers in the field of paleontology during the nineteenth century. Cope was then associated with the Academy of Sciences in Philadelphia. Under Professor Cope's direction, William Hosea Ballou had written an article on extinct reptiles for *Century Magazine*, and the professor's disciple, Osborn, suggested that his disciple, Knight, provide the illustrations, based on Cope's pencil sketches.

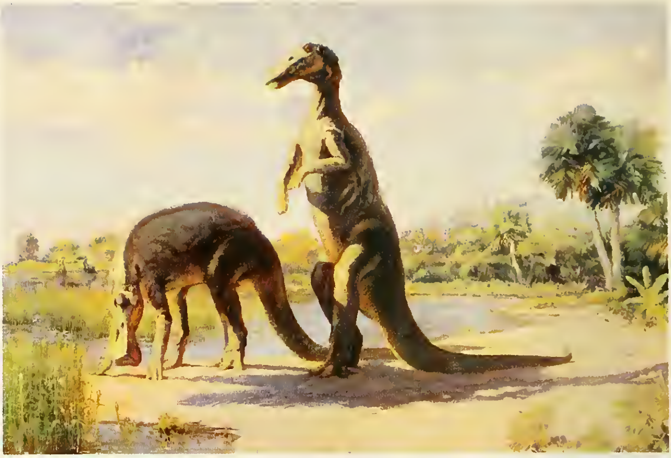
Anxious to meet the legendary Cope, Knight went to the scientist's red-brick dwelling at 2102 Pine Street in Philadelphia. Hardly a detail of the place seemed to escape his memory when he later wrote of that first visit:

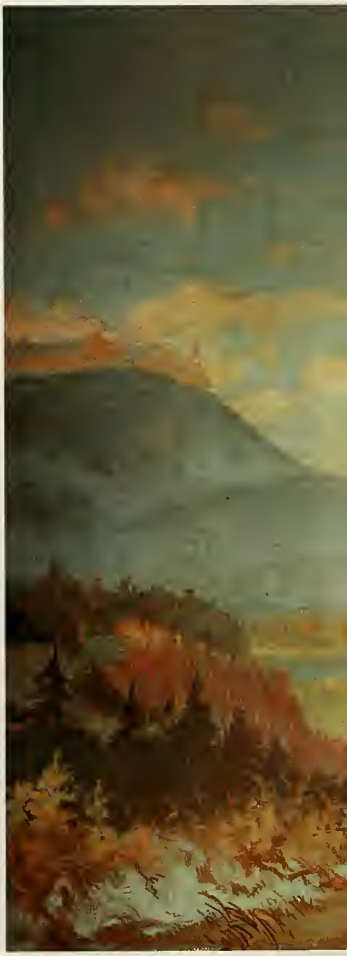
> Inside everything was unique and completely dust covered. Never have I seen such a curious place—just like the kind that Dickens would have loved. Piles of pamphlets rose from floor to ceiling in every narrow hallway, leaving just enough room to squeeze by them and no more. At the right as I entered, I looked into the front

parlor. Shuttered with inside blinds, the floor was completely hidden by the massive bones of some vast creature, probably a dinosaur. Dust lay thick here as elsewhere, and the place was absolutely bare of furniture and hangings. No pictures, no curtains, nothing but petrified skeletons of extinct monsters more or less carefully disposed in every available open space. This in itself was peculiar, but it merely introduced one to the strange sights to be encountered in this almost sinister domicile. The second floor, to which I was promptly conducted, was reached by a narrow stair, the wall side of which carried small shelves holding pickled snakes and other reptiles in bottles. The back room on this floor was a long, narrow affair with a bay window overlooking a meager garden. This room, sacred to all good Philadelphians as a sitting room or back parlor, was one of the most singular places I have ever seen. It, too, was littered with various objects from end to end, all piled helter-skelter on tables, chairs and shelves. A human skull grinned at me from the mantle, and a large bronze vulture spread its menacing pinions above a cage containing a living gila monster. Bones, recent and fossil, were everywhere, all dusty, and all in apparently inextricable confusion. But Cope himself, the presiding genius among all this scientific chaos, met me with a genial and charming smile, made me sit down and talked as only Cope could talk, about the things I came to discuss.

Before long Knight and Cope were heavily engaged in their discussions of prehistoric life. Impressed by Knight's thirst for the truth about ancient subjects, Cope set up a makeshift studio for him at a drawing table in the bay window, "the only free space in the room." Here Knight spent two weeks studying Cope's pencil sketches and learning how Cope had arrived at his conclusions regarding his creatures' possible form and proportion. "Under his expert guidance," Knight wrote, "I felt that I had stepped back into an ancient world—filled with all sorts of bizarre and curious things, and in imagination I could picture quite distinctly just what these mighty beasts looked like as they walked or swam in search of food." Like Osborn and Knight, Cope regarded paleontology not merely as the study of brittle fossil remains but as a science in which knowledge of the present might explain and give life to those denizens of the past.

Unfortunately, Cope, who had been ailing when Knight first came to visit him, never saw the fruits of their meetings. Three weeks after Knight left him, Cope died. Knight's restorations did appear in an 1897 issue of *Century Magazine*, however, a testimony to the men's brief association. The paintings, depicting Cope's leaping dinosaurs and other saurians, graced with near photographic realism two articles in that issue, Ballou's "Strange Creatures of the Past" and another piece by Osborn.





Above, trachodont; right, great Irish deer

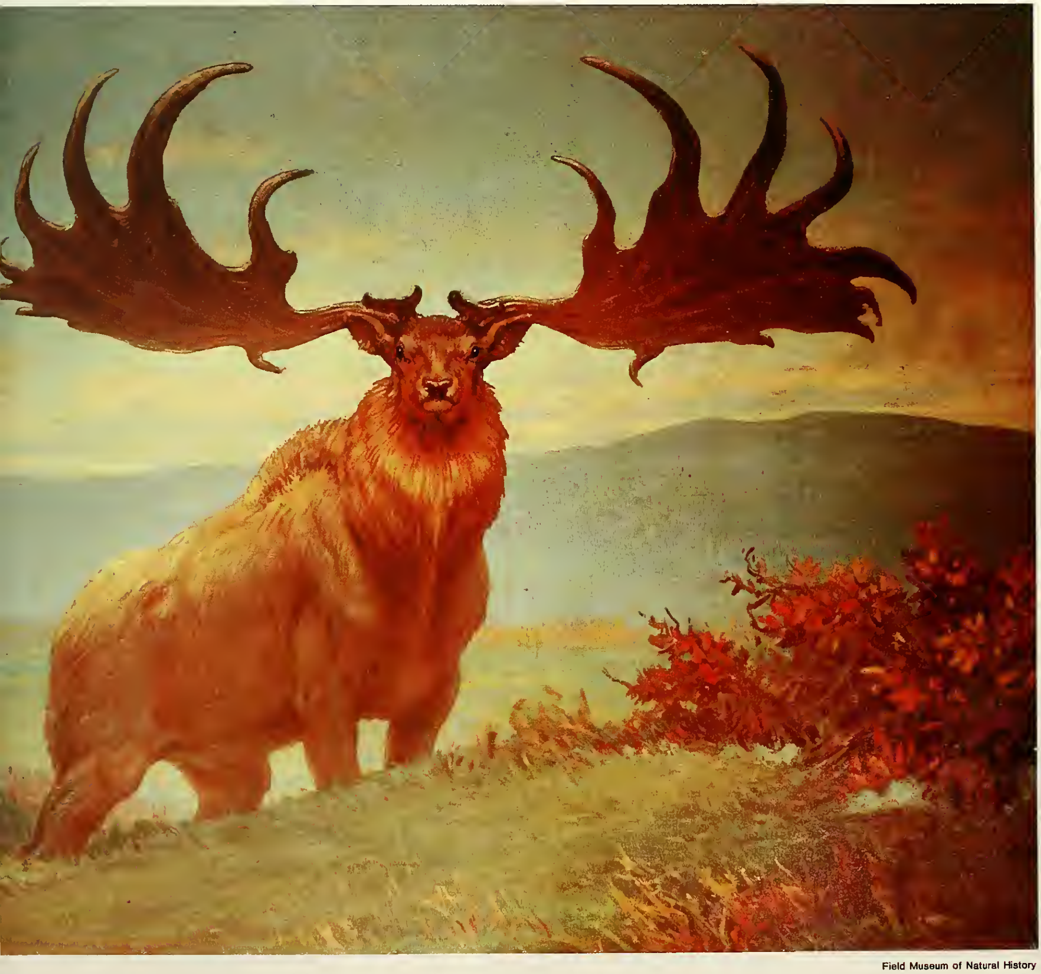
Through the efforts of Osborn and the talents of Knight, a new public awareness and interest in prehistoric life was being born. People flocked to the paleontology halls of the American Museum of Natural History to see the newly acquired skeletons, mounted in exciting, realistic poses, and the life restorations by Knight, whose work was already known through the popular press. Public interest in the Museum was at an unprecedented high.

By the spring of 1898, Osborn managed to bring some small aspects of the Museum outside its walls and to the public directly through a catalog of models, casts, and photographs of restorations of fossil vertebrates that could be purchased by interested parties. Osborn hoped that the items would help to spread information about extinct creatures to interested, though uninformed, people. Later, through a survey conducted by staff members of the Museum's Department of Vertebrate Paleontology, it was learned that, to Museum visitors, the most meaningful fossil exhibits were those accompanied by Knight's watercolor life restorations.

Encouraged by the public interest in the Museum, a number of wealthy benefactors, J.P. Morgan among them, made generous donations to the institution. Morgan had already donated to the Museum a complete mastodon skeleton (the so-called Warren Mastodon, bought from a Dr. Warren, who had been maintaining it in his Boston museum), along with many other treasures.

Making good use of Morgan's friendship and generosity, Osborn easily convinced him to pay the bills while Knight produced a score of watercolor and sculpture restorations of prehistoric life. If the restorations were not entirely accurate in light of present-day paleontological knowledge, they were correct in regard to what was known scientifically at the time. By 1898 Osborn prepared another catalog, making available to scientific schools, colleges, and students not only reproductions of Knight's finished works but also copies of the small preliminary models he sculpted prior to making his paintings. As for Knight's original pieces, Osborn talked Morgan into buying them and then donating the collection to the Museum. With this donation, Knight's association with the American Museum of Natural History was secure and would remain so for many years.

Gradually Knight assumed celebrity status at the American Museum. Earlier in his career he had based his works largely on the mounted skeletons on display in the galleries; now newly acquired specimens were being set up to mimic the poses in his restorations. The artist had entered the realm of prehistoric-animal art only to become, so short a time afterward, its premier creator. The scientific world was rapidly coming to acknowledge that when it came to restoring extinct creatures Knight was the expert. Although Knight produced works for numerous major institutions and publications, he maintained strong connections with the American Museum for more than forty years. Edwin H. Colbert, a former curator of vertebrate paleontology at the American Museum of Natural History and a friend of the late artist, said of him: "Knight's restorations of extinct animals are great not only because of his inherent abilities as an artist but also because of his readiness to work with scientists . . . his was a constant quest for truth in art and in science . . . he had so much imagination that he could project himself back in time and feel that he was on a cliff with one of those monsters." □



Field Museum of Natural History

Wild White Sheep

The rugged mountain ranges of the Far North provide the acrobatic Dall's sheep with food and protection from predators

by George Wuerthner

photographs by Johnny Johnson

The wind ripped snow from the high ridges of the Alaska Range, and the intense cold pierced through me. Snow squeaked beneath my feet and flew in the wind like dust. Above me stood the white forms of Dall's sheep. They stared in my direction as I inched up the ridge until the wind forced me to seek shelter in the lee of a large boulder. As I fumbled with stiff fingers to focus my binoculars, the sheep vanished behind the ridge, as had happened so many times before. I gave up my stalk and returned to the warmth of my camp down in the tree-sheltered valley.

The harsh climatic conditions and rugged terrain did not discourage the intrepid naturalist William Dall, for whom the species is named. He had explored the interior of Alaska in the mid-1800s while surveying a telegraph route along the Yukon River. Dall, then only nineteen, became fascinated with Alaska and spent many years collecting specimens and publishing material on Alaska's little-known fauna. Dall's sheep (*Ovis dalli dalli*), the only wild sheep found in Alaska, are closely related to the bighorn sheep that range from southern Canada to Mexico. A dark colored subspecies of Dall's sheep, Stone's sheep (*Ovis dalli stonei*), inhabits northern British Columbia and adjacent portions of the southern Yukon Territory. The white Dall's sheep and the dark Stone's sheep are grouped together to form the thin-horn sheep, distinguishing them from the more southerly bighorn sheep.

Thin-horn sheep, as the name implies, have thinner, more delicate and more widely flaring horns than their cousins, the bighorns. Thin-horn sheep are also smaller in body size than bighorns. But in most other respects the thin-horn and bighorn sheep are similar, reflecting their probable common ancestry. Both thin-horn and bighorn sheep inhabit mountain areas, feed primarily on sedges and grasses, and have a male dominance hierarchy based on the size of an individual's horns.

The evolutionary development of these sheep was shaped by the continental glaciation that covered much of North America 40,000 years ago. The ancestral form of today's thin-horn and bighorn sheep was able to cross into North America from Asia during this glacial period because so much water was frozen that the level of the earth's oceans dropped 300 feet and a wide flat plain connecting Siberia and Alaska was exposed. While Alaska's mountains were buried beneath ice, most of the interior of the present-day Yukon River valley remained ice free. This open zone, or refugia, allowed many animals to survive the glacial periods while virtually surrounded by an icebound landscape.

The margins of the great ice sheets did not remain static but constantly advanced and retreated; several times an ice-free corridor extended from Alaska south to the Great Plains of Montana. Many Ice Age mammals, including sheep, migrated along this corridor to colonize the lands south of the ice sheets. When the glacial ice closed the corridor, the ancestral form of contemporary Dall's sheep separated geographically into two groups. Those in the north evolved into the thin-horn sheep, while the group to the south eventually became the bighorns of today.

Dall's sheep are seldom found far from steep mountain ridges. When threatened, they flee toward rocky inclines so precipitous that a terrestrial predator could not give chase.

As the Ice Age came to a close, thinhorn sheep spread into most of the mountain ranges of Alaska and northwest Canada. Today, Dall's sheep can be found in Alaska within sight of salt water in the south of their range; to the north, their range extends beyond the Arctic Circle to almost within sight of the Arctic Ocean. Seven major mountain ranges in Alaska have populations of Dall's sheep: the Brooks Range, Alaska Range, Talkeetna Mountains, Kenai Mountains, Chugach Mountains, White Mountains-Tanana Uplands, and Wrangell Mountains.

The first Dall's sheep I ever saw was near the headwaters of Sunset Creek, near the flanks of Mount McKinley in Denali National Park and Preserve. I had backpacked into an alpine basin with an active glacier crowning the mountain above me. The evening sky glowed pearl gray, a color typical of Alaskan summer twilight. A rainstorm had just passed, and the clouds were breaking up, revealing the towering peaks that walled me in on three sides. I reached the top of a ridge and surprised three ewes that were grazing. Startled, the sheep ran toward nearby cliffs at the base of the glacier. I set up camp, and the sheep, finding me no immediate threat, again began to feed.

I didn't know it then, but many characteristics of Dall's sheep behavior and natural history were displayed in that incident. For instance, although the sheep graze on gentle slopes, they are never found far from rough mountainous terrain. The close affinity of Dall's sheep with mountains is not coincidental: mountains represent security because they effectively limit the ability of terrestrial predators to pursue and capture the sheep. On rugged cliffs and rocky terrain, sheep can easily outdistance any predator. The advantage Dall's sheep have over predators is easy to understand if you watch them as they nimbly hop, jump, and run along narrow ledges with sheer drop-offs that would make a tightrope walker nervous. Whenever sheep perceive danger, they instinctively retreat to the security provided by rocks and cliffs.

Not all wild North American sheep are found in mountains. Less than 100 years ago, the now extinct Audubon's bighorn sheep lived among the breaks and rough coulee country of the Missouri River in the Great Plains of eastern Montana. In Alaska today, some Dall's sheep inhabit riverside cliffs along the Charlie River in the rolling hill country near the Yukon River. These sheep do not live in mountains, but they do select broken terrain that seems essential for defense against predators.

Dall's sheep live on mountains and cliffs for reasons other than predator evasion. In winter, south-facing cliffs heat up on sunny days, and snow accumulations melt. The cliffs are often warmer than the adjacent valleys because cold air tends to sink. Charles Sheldon, an early naturalist of the Mount McKinley area, described this phenomenon in his book *The Wilderness of Denali*. Sheldon recorded the temperatures on winter days both in the valleys and higher up on the mountain slopes. He found that while air temperatures would dip to 40 below zero in the lowlands, temperatures a thousand feet higher might be 20 degrees warmer. A thermal difference of this amount means sheep burn fewer calories to stay warm and thus survive the winter.

The glacier I'd seen in my first encounter with Dall's sheep served to emphasize the role of ice in the evolution of these animals. Biologist Valerius Geist, an expert on wild sheep and other ungulates, has postulated that after the retreat of the Pleistocene glaciers, some sheep populations expanded into formerly ice-covered terrain and underwent a more rapid physical and behavioral evolution than those remaining in established ranges. More highly evolved wild sheep tend to have bigger horns and larger bodies and are behaviorally inclined toward head-battering displays. According to Geist, microclimates are most variable in the immediate vicinity of glaciers. Environmental variability favors relatively low population densities of sheep, allowing for more food per individual and, consequently, larger bodies and horns in both males and females. This theory may explain why sheep in the Brooks Range, where present glaciation is confined to small remnant glaciers, are the smallest in the state.

New habitat made available by retreating glaciers is only one of several factors that affect sheep distribution. Research by biologist Lyman Nichols has shown that strong winds are one of the most important environmental factors in Dall's sheep ecology. Frequent winds blow away the snow cover and expose the plants that make up the sheep's diet. Since winds are strongest over treeless alpine areas, these are the places one usually finds wintering sheep.

Dall's sheep also require a fairly dry environment, particularly during the

A sexually mature ram performs a "lip curl," left. This behavior usually follows the examination of the urine of a female or a possible male competitor during the rutting period in late November and early December. Two rams in the background butt heads in a test of dominance. Three rams, right, graze on the tundra in Denali National Park and Preserve.

winter months. Snow is difficult for sheep to move through, and ice-crusted surfaces can form, making it impossible for sheep to graze. Thus, there is good correlation between areas of low precipitation and the presence of sheep. As a rule, areas where annual precipitation exceeds twenty-four inches will not sustain Dall's sheep because such moist regions usually support forests instead of the grasses that are the sheep's primary food. A recent transplant scheme seems to bear this out. The Alaska Fish and Game Department transported Dall's sheep to Kodiak Island in the hope of establishing a herd there. The island has an annual precipitation in excess of sixty inches, and the sheep do not appear to be multiplying.

Death comes to Dall's sheep in many ways. Predation by wolves, grizzly bears, wolverines, and golden eagles takes a toll. Some sheep die of starvation because their teeth have worn down to the gums, a condition that can be caused by years of eating dust-covered grasses. (The source of the dust is glacier-fed streams carrying finely ground rock in solution. When water levels drop, the silt dries and is blown over the countryside.) A few sheep suffer physical injuries, such as broken legs, that render them helpless. All these forms of mortality are overshadowed, however, by the impact of severe winters, particularly those with deep snow. Dall's sheep are most vulnerable in their first years of growth. In some populations, more than 50 percent of newborn lambs do not survive their first winter. Sheep go through a yearly energy cycle, storing excess calories as fat reserves during the summer and living off their stored fat in winter when high-quality food is difficult to obtain. Young sheep, however, expend most of their caloric intake on growth and so are unable to store up large fat reserves.

Dall's sheep in all age categories make behavioral adjustments to meet the stress of winter. When not feeding, the sheep seek shelter behind boulders or in caves, thereby keeping radiant-heat losses to a minimum. The sheep also alter their summer schedule of early morning and late evening feeding periods and feed at midday, when temperatures are warmest.

The sheep also change their seasonal ranges. In Denali National Park and Preserve, the Dall's sheep migrate from high summer ranges where snow gets too deep for them to survive the winter. They move as much as fifteen miles to

While suckling, a five- to six-week old lamb is nuzzled by its mother, left. Lambs receive little other attention. In one form of play behavior, a lamb has clambered onto its mother's back, above.

lower, drier winter ranges. Although sheep will migrate, they are not wanderers like the caribou; they remain loyal to their established ranges and seldom stray into new areas.

This loyalty to established ranges affects the social behavior of Dall's sheep. Animals such as moose, which colonize primary and secondary successional plant stages, force their young to leave their parents' home range to find untapped food sources of their own. Unlike moose, sheep graze on climax plant species, and except in cases of long-term climatic change, the amount of habitat available to them does not change dramatically from year to year. Climax grasslands were once much more extensive than today, so many sheep populations are isolated on small islands of suitable habitat that are separated from other usable ranges by forested areas. As a result, young Dall's sheep seldom leave their parents' bands. They learn a band's migration routes by following the older sheep.

Dall's sheep are gregarious, remaining in bands throughout the year. The larger mixed bands comprise adult ewes and yearling ewes and rams, with an occasional ram as old as two and a half years. As the rams mature, they move off to join bachelor bands. Adult ewe and lamb bands can range in size from five to one hundred individuals, with an average size of ten to twenty. Bachelor bands can range from two to fifteen individuals, with an average size of four to eight.

Lambs are born into the mixed bands in May or early June. A pregnant ewe usually leaves the band to give birth on secluded cliffs, which afford the lamb protection from predators and cool winds. Newborn lambs are precocious and can walk within a day. In less than a week, they can keep up with their mothers on the steepest terrain. During the first few weeks the lambs stay close to the ewes, but as the summer progresses they become increasingly independent and mix freely with other members of the band. The lambs often form play groups. Play has great survival value, preparing the young animals physically and socially for the rigors of life. Near the headwaters of the Itkillit River in the central Brooks Range, I once observed three young lambs engage in a sheep's version of "king of the mountain." One lamb would climb to the top of a rocky outcrop and defend it from the others when they attempted to gain the summit. Eventually one of the "attackers" would successfully dislodge the "king" and assume the role of a new king of the mountain. Another game involved lambs sliding down a slope of small, loose rocks with all four of their feet bunched beneath them as if riding a sled. Upon reaching the bottom of the slope they would quickly run back to the top of the chute to repeat the slide. Such games prepare a sheep for real situa-

This band of ewes and lambs is cautiously making its way to its winter range. These Dall's sheep are found in the Central Alaska Range in Denali National Park and Preserve.

tions where muscle coordination and strength are vital.

The mature rams in the bachelor groups establish a dominance hierarchy based on horn size. The largest-horned ram will sometimes be challenged by other rams in butting contests, especially if two individuals are of similar horn size and strength. But more frequently, the other rams will accept the leadership of the largest-horned ram without combat.

The dominant ram frequently displays his horns. A displaying ram approaches another ram and lowers his head, twisting it to the side so that the horns can be clearly seen. These horn displays help avoid constant combat between members of a bachelor group since a ram with smaller horns can easily ascertain when he is outclassed and thus act obsequiously toward the larger male.

A dominant ram has many privileges. Some of them may seem to have little advantage except that they help reinforce the roles of dominant and subordinate. For instance, only a dominant ram may place his throat upon the back of the neck of another ram without reprisal. Only the dominant ram may stare directly at another ram without averting his eyes. The dominant male treats all other sheep, regardless of their age or

sex, as if they were females. Thus the dominant ram will mount subordinate rams, which, in turn, not only accept this behavior but even assume the behavioral characteristics of a female.

Foremost of the dominant ram's privileges is the right to do most of the breeding. Females seem to prefer large rams for mating and will avoid breeding attempts by smaller rams. Estrous females will usually be guarded by the dominant ram, which attempts to prevent all other rams from breeding with her. He is not always successful, however. Often while the dominant male is off chasing one ram, another will mount the estrous female.

The rams that become dominant are almost certain to die within a year or two after having achieved that status. Fighting more and breeding more than males with smaller horns, dominant rams expend considerable amounts of energy to keep the other rams from mating. As a result, the dominant rams lose most of their body fat reserves during the November breeding season and face the winter in very poor physical condition. Many of these rams do not survive the winter and die an early death.

The wild sheep populations in the lower forty-eight states have declined over most of their ranges; compared with them the Dall's sheep of Alaska are stable and remain close to their numbers before the advent of the white man. It is the white man, with his guns, livestock, and range destruction, who has caused bighorn sheep populations to dwindle to a fraction of their former numbers. Fortunately, Alaska's wild sheep have been spared most of these problems thus far. Hunting is highly controlled and poses no threat to most herds. Also, the recent Alaskan national park legislation has given protection to about half of the estimated 40,000 Dall's sheep in Alaska. If no further human encroachment takes place, these ghostlike sheep of the north will survive to become a living link between Alaska's past and future. ☐

Whooper Recount

A close look at these endangered cranes reveals that, while their numbers are increasing, their rate of increase is actually declining

by Paul A. Johnsgard

During the early 1930s, Myron Swenk of the University of Nebraska performed a detailed analysis of the records on whooping cranes during their migrations through Nebraska. The extent of the birds' wintering areas had not yet been ascertained, and their breeding grounds were completely unknown. Swenk believed that most of the cranes that survived the winter passed through the Platte Valley of Nebraska each spring on their way northward. Using information collected from correspondents, newspaper accounts, and the like, he was able to provide data on the timing and general locations of whooping crane concentrations in the state.

Unfortunately, in attempting to assess total whooping crane numbers, he accepted almost without question the sightings of large flocks of birds identified as whooping cranes, but which were most probably sandhill cranes or possibly even snow geese. This resulted in a tally of nearly 700 whooping cranes for the spring migration period during the twenty years prior to 1933, leading Swenk to the erroneous conclusion that as many as one hundred of the birds survived into the early 1930s. In sum-

Elthe

Experiments using sandhill cranes as foster parents for whooping cranes have had limited success. Here one of the surviving juvenile whoopers, center, mingles with two sandhills.

Robert P. Carr

marizing his work, Swenk reported that he could detect "no permanent diminution in numbers of the species observed in Nebraska, during the past few decades," and actually suggested that there had been a "distinct recovery of the species since 1916," when the Migratory Bird Treaty was enacted.

Swenk's findings provided a deceptive assurance to various ornithological and conservation groups, as well as to federal agencies. U.S. Fish and Wildlife Service biologists remained unaware of the cranes' perilous state, and as late as 1943 the Bird Protection Committee of the American Ornithologists' Union published a bland 1938 estimate that the whooping crane population was probably "less than 300." According to regional surveys, however, there then were only eleven resident birds in the White Lake marshes of Louisiana, two more in the coastal marshes of the same state, about twenty that wintered annually on the Texas coast, and a captive bird that had been illegally wounded in Nebraska in 1936.

Eventually, the attention given to the status of the whooping crane gave rise to highly accurate annual counts. These, in turn, led to effective conservation measures on behalf of the birds. The history of the cranes' increase in numbers over the years provided me with a unique base for the study of their population dynamics.

The establishment of a national wildlife refuge near Aransas Bay, Texas, during the winter of 1937–38 was of crucial importance to the fate of the cranes and probably saved the species from extinction. The Louisiana marsh population had declined precipitously to only six birds by the winter of 1941–42, and the large number of "whooping cranes" that had been reported almost every previous spring in Nebraska simply failed to materialize on close study. Thus, ornithologists came to the sobering realization that the Texas wintering population was essentially all that was to be found anywhere. By the winter of 1941–42, the Aransas population had dropped to an all-time low of thirteen adult birds and two young, which possibly represented no more than two or three actual breeding pairs. The fate of the whooping crane was invested in these few birds, which carried the total genetic pool of a species that had probably numbered between 1,300 and 1,400 birds some seventy-five years previously.

Initially, the establishment of the Aransas refuge did not seem to help the species' plight. The birds were often disturbed by activities associated with oil production in nearby San Antonio Bay, the construction of the Intracoastal Waterway through the heart of the refuge, and practice bombing on Matagorda Island by military aircraft. Nevertheless, the refuge did provide protection from illegal hunting of the birds, and detailed monitoring of their numbers was possible for the first time. This became especially important as the Louisiana flock gradually diminished. In the winter of 1949–50, the last surviving bird of that flock was captured and transferred to Aransas to join the thirty-four wild birds that had arrived that autumn. By then the wounded bird from Nebraska and a second captive whooping crane from the New Orleans zoo had also been moved to Aransas.

By the winter of 1949–50, the whooping cranes, responding well to protection, more than doubled in number. But the future of the species was by no means secure, for every year the birds had to cross the continent to and from their still-unknown nesting grounds. Special efforts were made to locate and preserve their nesting areas. Much of this work was undertaken for the National Audubon Society by Robert Porter Allen, who doggedly searched thousands of square miles of the Canadian and Alaskan Arctic and subarctic. He began his unflagging endeavors in the fall of 1946, and for several years publicized the whooping crane story with press releases and articles. His hopes were finally realized in 1954, when a mammalogist doing a helicopter survey for the Canadian Wildlife Service accidentally discovered the cranes nesting south of Great Slave Lake, in a remote corner of Wood Buffalo National Park, Northwest Territories. (The area is probably marginal crane habitat, as the cranes' original nesting distribution had centered in the aspen and prairie parklands of southern Canada and the upper midwestern states—areas from which the birds had been eliminated early in the twentieth century.) Fortunately, this nesting area had already been placed under protection as a sanctuary for Canada's remaining herd of wood buffalo. The discovery was important because it finally settled the question of the species' remaining nesting grounds, and allowed for subsequent monitoring of its nesting biology and reproductive success.

The whooping crane population wavered erratically through the 1950s, dropping thirteen birds between the winters of 1949 and 1952, but rising to a high point of twenty-two adults and nine young birds that reached Aransas in the fall of 1958. The birds then began a slow recovery that has progressed, with few interruptions, up to the present wild population of about ninety-six birds. Since 1938, the number of adult and young birds arriving safely at Aransas has been carefully recorded and the

information annually released to the press. Conducting a complete census of the population of an endangered species at the same time every year has provided a rare opportunity to measure its annual increments and losses, and to predict some demographic characteristics that are extremely relevant to the species' chances for long-term survival.

A chronological plotting of the total number of wild whooping cranes in the Aransas flock since the establishment of the refuge, along with a parallel plotting of the number of young birds and apparent deaths per year (based on the number of birds from the previous year's population that fail to arrive the following fall), is of special interest. The annual mortality, varying from 0 to 13 birds, has remained remarkably constant, showing no sign of increase as the population has risen since the mid-1950s. Equally surprising is that the number of young, varying from 0 to 12 per year, has also remained uniform and has shown no proportional relationship to the number of nonjuveniles in the population during the same period. Neither of these results is to be expected, for both the number of deaths and of young birds should be proportional to the population size.

A simple chronological graph, although of interest, fails to provide a statistical estimate of the life history characteristics that are most needed by biologists. Instead, estimates of annual mortality rates and of recruitment rates, or annual additions of juveniles into the population, are needed. Fortunately, these statistics can be calculated from the population data that have been accumulated since 1938. Robert Porter Allen assembled this information for the wild populations in Louisiana and Texas during the period from 1938 to 1948, and data for the subsequent years from Aransas were assembled, although never carefully analyzed, by the U.S. Fish and Wildlife Service.

I have assembled these figures for the 43-year period from 1938 through 1980, and have subjected them to various kinds of analysis. During this period, 220 young and 1,437 postjuvenile birds have appeared on the wintering grounds. This works out to an annual recruitment rate of 13.3 percent. (This is not exactly the same as the birthrate, of course, since the loss of eggs, chicks, and juveniles prior to arrival at Aransas is excluded.) The recruitment rate provides an estimate of the rate of maximum annual population increase. One hundred fifty-four birds that had been

Illinois State Museum and Christopher J. Schuberth, Geologist, and Curator of Education present the **11th Annual**

EAST AFRICAN GEOLOGIC AND WILDLIFE SAFARI

July 26—August 16, 1982

Koobi Fora...Kilimanjaro...Mombasa... famed place names in Kenya.

Tsavorite gemstone...Rift Valley..."1470" Skull... are equally well known to science.

A once-in-a-lifetime 2,000-mile educational holiday adventure in a magnificent land where lion is king, the giraffe is curious about you, and their homes in the Serengeti, the Mara, Samburu, Amboseli, or Tsavo will become as familiar to you as they are to them. Truly a custom-designed itinerary, you travel in the company of others with your interests and under thoroughly experienced, knowledgeable, and dedicated leadership.

For a detailed brochure or further information, call or write:

Christopher J. Schuberth
Illinois State Museum
Springfield, IL 62706
Phone: (217) 782-7386

Treasures From The Earth

Color Portfolio of Natural Specimens and Catalog of Minerals, Display Stands, Books and Natural Jewelry, $3.00

Dover Scientific
Box 6011C Long Island City, NY 11106

EXPLORE DARWIN'S
GALAPAGOS
THE BUCCANEER
"Largest Galapagos ship"
Cruises from $477 Plus Air Fare

All outside Air conditioned Staterooms, Private baths. Includes all meals aboard. Shore excursions conducted by multi-lingual naturalist guides.

Also visit **MACHU PICCHU, THE AMAZON, QUITO, LIMA, CUZCO, IQUITOS** on new low air fare

Write for brochures, deck plans, tariffs, itinerary

GALAPAGOS, Inc.
Suite 112-C, 7800 Red Road, So. Miami FL 33143
Name ______
Address ______
City/State/Zip ______

FREE
HUDSON'S
Spring Catalog

NH-2

Send today for your free color copy of the Hudson's 1982 Spring Catalog of fine recreational equipment and clothing.

Our 64th year of providing field-tested, rugged clothing, footwear and accessories at reasonable prices for men and women.

All merchandise is fully guaranteed and Hudson's pays all freight within the Continental U.S.A.

Rush my FREE Catalog to:

Name ______
Address ______
City/St./Zip ______

HUDSON'S
97 3rd Ave., NY, NY 10003

counted in any given year failed to arrive the following fall and can be considered mortalities. The deaths of these postjuvenile birds, when considered relative to the collective population of surviving postjuveniles, indicate an overall relative mortality rate of 9.7 percent for the 43-year period. Subtracting the annual mortality rate from the annual recruitment rate provides the actual annual rate of population increase: 3.6 percent. Such a rate of increase, which is comparable to that of many human populations, results in a theoretical population doubling time of 19.2 years. Indeed, the wild population has essentially doubled twice in the nearly fifty years since the establishment of the Aransas refuge.

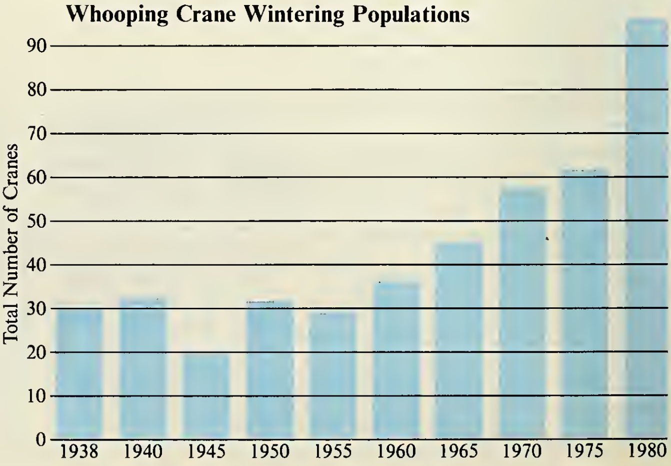
An annual mortality statistic of 9.7 percent for postjuveniles also allows for an estimate of life expectancy in the population. If this mortality rate is typical of all older age classes, the expected life span for a crane that has survived to reach Aransas is approximately ten years. Furthermore, more than 5 percent of the postjuvenile population might statistically be expected to reach the age of twenty-five years, and a few might even survive to forty years. (Whooping cranes have been known to live for forty years in captivity, but too few have yet been banded to judge whether such ages might actually be attained in the wild.)

This estimated life span surprised ornithologists, who are inclined to believe that most wild birds have a much higher annual mortality rate and a shorter life expectancy. Discussing the plight of the whooping crane in the 1950s, James Greenway of the American Museum of Natural History took the position that the species' survival would be a "miracle," as he assumed that its first-year mortality rate might be as high as 80 to 90 percent, and perhaps as high as 50 to 75 percent in later years. Obviously, if that were true the species would have died out long ago. Instead, the whooping crane is a species that has evolved a pattern of survival based on a potentially long life span, permanent pair bonding, and prolonged biparental care of only one or two young.

One important factor in the life history of the whooping crane is still uncertain: the length of time to sexual maturity and initial nesting. By the time they are two years old, whooping cranes attain their adult plumage, and some two-year-olds have been observed displaying; but it is generally believed that initial nesting probably does not occur in wild birds until the whoopers are at least five years old. The evolutionary wisdom of restricting breeding attempts to the oldest and most experienced age classes probably relates to competition among adults for highly limited nesting sites, the extremely large territorial requirements of nesting pairs, and the high demands on the parents for guarding the nest and young during the relatively long (four-month) period of incubation and fledging. The subsequent migration of some 2,300 miles from the Canadian subarctic to the Gulf Coast is an additional stress, and thus it is in the best interest of the species to restrict nesting efforts to those individuals that have already survived for several years and have both the physical strength and experience necessary to breed under these difficult conditions. Probably less than half of the adult-plumaged birds in the population at any one time actually represent breeding birds, with the remainder consisting of subadults, widowed birds that have not found new mates, and perhaps some birds too old to breed. Allen estimated that only half the spring migrant population of whooping cranes represented potential breeding pairs; this figure was later supported by studies on the Canadian nesting grounds, where it was found that somewhat less than half the birds that summered in the Sass River area of Wood Buffalo National Park were actually nesting.

This restriction of breeding potential to a relatively few birds that might be anywhere from about five to nearly forty years old is an important facet of whooping crane biology. For one thing, it means that the genetic diversity of the offspring is restricted. It might also help to explain the curious fact, noted earlier, that the number of offspring produced each year has tended to remain constant. The older and more experienced breeders are also probably less vulnerable to the usual sorts of mortality factors, such as accidents and injuries caused by hunters. Thus it is probable that many of the annual deaths are those of first-year or at least subadult birds. There seems to be a weak but positive correlation between the number of young appearing on the wintering grounds in any given year and the size of the apparent mortality during the following year or two, suggesting that after yearlings are abandoned by their parents, they are likely to suffer higher mortality rates than older birds.

When the data are broken into three approximately equal time segments, some additional information can be gleaned. During the critical early period from 1938 to 1952, the annual recruitment rate (the percentage of young in the fall population) was 17.3 percent. In the transitional period from 1953 to



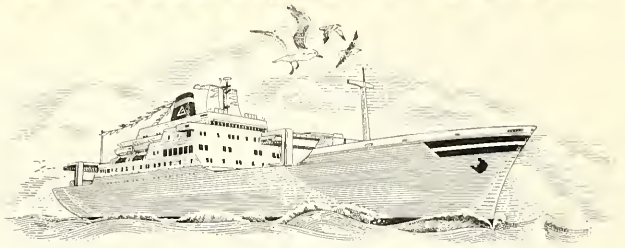
The increase in whooping crane numbers has been documented yearly at the Aransas National Wildlife Refuge in Texas. Totals for 1938, 1940, and 1945 include the now extinct Louisiana population; birds from the Gray's Lake, Idaho, flock, which overwinter in New Mexico, are counted in the 1975 and 1980 totals.

1966, the recruitment rate was 15.1 percent, and during the most recent period from 1967 to 1980, it was only 10.6 percent. The mortality rates during these same three periods were 15.8 percent, 10.8 percent, and 6.7 percent, respectively, the decline apparently reflecting improved protection and decreased mortality from hunting errors. Finally, the annual rates of increase (the annual rate of recruitment less the annual mortality rate) for the three periods have been 1.5 percent, 4.3 percent, and 3.9 percent. Thus the annual rate of increase was highest during the middle portion of the period under consideration and has diminished some since that time.

Part of this reduction can perhaps be attributed to the removal since 1967 of a moderate number of eggs from whooping crane nests for hatching elsewhere. No more than a single egg from any nest has been removed, based on the observation that wild cranes rarely manage to rear more than a single youngster whether or not two eggs are present. Between 1967 and 1974, a total of fifty such eggs were removed for rearing at the Patuxent Wildlife Research Center in Laurel, Maryland; and more recently, a similar number have been transported to Gray's Lake, Idaho, and substituted for those of greater sandhill cranes, in hopes that the sandhills would brood them and raise the young.

Current hopes for the establishment of a second, and perhaps less vulnerable, whooping crane flock rest primarily with the recent efforts at cross-fostering whooping crane chicks under sandhill crane foster parents, and within a few years we should know whether these efforts will prove successful. The experiments began in 1975, and during the first four years a total of thirteen birds fledged from forty-five eggs that were placed under foster parents. Only three of these birds were known to still be alive at two years of age, however, and thus the rate of population increase has been agonizingly slow. Added to this disappointment is the uncertainty of whether the fostered cranes will be able to find appropriate mates when they become sexually mature or whether, if out of need or because of attachment to inappropriate parent figures, they will attempt to mate with sandhill cranes. Thus, the role of the older, wiser, and more experienced birds in the grand design for the preservation of the species becomes ever more evident; youngsters just don't seem to have what is needed to make it through these difficult times. ☐

54 Rms., Ocean Vu.



Delta's luxurious 20,000-ton Cruiseliners set sail for South America with just 100 pampered passengers.
Join us.
For details on our fortnightly sailings, see your Travel Agent or send us this coupon.

Ships of U.S. Registry.

Delta Line Cruises 2700 Steuart Street Tower
One Market Plaza, San Francisco, California 94106
(415) 777-8300

Please send me your colorful Cruise Brochure.

Name ____

Street ____ Phone ____

City/State/Zip ____

My Travel Agency is ____

NHB

Delta Line Cruises

The only 100-passenger Cruiseliners.

It's just one short step between floors with *"Elevette"*!

Step into this modern home elevator instead of climbing up and down the hard way. "Elevette" is a life-saver for the handicapped or elderly . . . is a convenience for the whole family. And the variety of color-coordinated designs includes one to complement your decor.

Write for free color-illustrated catalog.

Facts on "Elevette"; budget-priced, single-seat StairLIFT; Inclinette, the deluxe single-seat lift; INCLIN-ATOR, lift for 2 people. Tax deductible when recommended by doctor.

INCLINATOR COMPANY OF AMERICA
DEPT. 17
P. O. BOX 1557
HARRISBURG, PA 17105-1557

The Garden Way® Cart
runs circles around the wheelbarrow!

With this perfectly balanced Cart as your "constant companion" you'll be able to tackle all those back-breaking jobs with incredible ease! Build stone fences, move dirt, gravel, compost, and mulch for the garden.

Nearly every job is a joy when you use this BIG new Cart. Easier to handle than the common wheelbarrow.

Also available in do-it-yourself kits.
Send Now for free Cart Literature.

3 SIZES AVAILABLE

© 1982 GARDEN WAY INC

01

Garden Way Research
Charlotte, VT 05445, Dept. A1643C

Name ____

Address ____

City ____

State ____ Zip ____

INDIA
&
AROUND THE WORLD
with
Nepal-Sri Lanka-Bhutan
Burma-Thailand

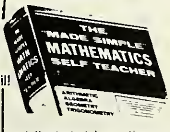
Journeyworld offers you the architectural splendors and unforgettable sights of some of the world's most creative civilisations. You will see the Taj Mahal, Kathmandu in the Himalayas, the stupendous rock carved temples of Ajanta & Ellora, Bhutan a fairy tale Buddhist kingdom, colorful Kandy in Sri Lanka, the glory of Pagan and Mandalay the elephant camps and tribal villages of Chieng Mai.
The programs include comprehensive sightseeing, deluxe hotels and all meals.

For information call or write:

JOURNEYWORLD
155 East 55th St., New York, N.Y. 10022
Tel: (212) 752-8308

MADE SIMPLE MATH Self Teacher
New Short Cut Math Skills in Only Weeks –10 minutes a day ...for Higher Pay Jobs.

BONUS! with Math book Pocket "Math-Wizard"
Get the Right Answers in a Flash Without Paper or Pencil!
Instant answers convert fractions into decimals, percentages and reverse. Plus other tough math problems solved in a jiffy!



One volume contains all subjects—arithmetic, algebra, geometry, trigonometry through calculus. Tackle any math problem even if you never finished high school. Basic and advanced math taught in terms of everyday experience. Clearly presented step-by-step and illustrated. Learn theory and practice from "scratch", "brush-up", or reference. Summary makes review easy. Track your progress. Catch errors instantly. Pass civil service and job tests. A must for all office, sales, industrial jobs, home finances. Send $8.95 plus 95¢ for shipping. 30 day Money Back Guarantee.

VALCO • Dept. 798 • Box 2012, New Rochelle, N.Y. 10802

Wilderness River Trips
Experience the grandeur and excitement of floating a wild river. Join us on one of the 21 rivers we run in the West and around the world. For our 16-page color catalog contact:

ECHO:
The Wilderness Co.
6529 NH Telegraph Avenue
Oakland, California 94609
(415) 652-1600

Celestial Events

by Thomas D. Nicholson

The Moon The waxing moon is bright in the evening sky during the first week of February, at its first-quarter phase on February 1, and full a week later (on the 8th). The bright star near the gibbous moon on the 2nd and 3rd is Aldebaran in Taurus; on the 4th and 5th the moon is below Pollux and Castor (the Twins of Gemini); and the full moon (and the waning gibbous moon a night later) is near Regulus in Leo. During its waning phases, the gibbous moon passes close to Spica in Virgo on the night of the 12th, goes through last-quarter on the night of the 15th (near Antares in Scorpius), and becomes new on the 23rd. The early crescent moon should be visible again before the end of the month. Look for it in the west after sundown on the 27th or 28th. In March, first-quarter is on the 2nd, full moon on the 9th, last-quarter on the 17th, and new on the 25th. Perigee moon (nearest the earth) is on February 5 and March 4; apogee (farthest from the earth) on the 17th in both months.

Stars and Planets When Mercury passes the sun at inferior conjunction one hour before midnight (EST) on February 1, it enters the morning sky in the sense that it shifts to the right (west) of the sun and is above the horizon at sunrise. But that doesn't mean we can see it in the morning sky. As a matter of fact, it surely cannot be seen until possibly toward the end of the month, when it moves to its extreme position to the sun's right (greatest westerly elongation). And since this elongation is not a favorable one for viewing (the planet is too low at sunrise), we probably won't see it even then.

The point is that the name "evening" or "morning" star depends on whether the planet is above the horizon at sunset (evening star) or sunrise (morning star). It cannot be both. The appellation has nothing to do with whether we can see the planet or not.

This month, when Mercury moves west of the sun, all the planets are morning stars; all are above the horizon at sunrise. We will not see Mercury. Venus will be visible low in the southeast at dawn if the horizon is clear (because Venus is so bright). Mars, Jupiter, and Saturn rise well before midnight and will be a striking trio from late evening (rising in the east) until dawn (setting in the southwest). And, of course, Uranus, Neptune, and Pluto are too dim to be seen. Is it exceptional for *all* the planets to be morning stars all month? Yes. That doesn't happen very often. But it has no real significance except as it affects the appearance of the sky for sky watchers.

February 1: Mercury, in inferior conjunction (between the earth and the sun), enters the morning sky just before midnight. Saturn, now rising in the late evening, begins its retrograde motion (taking it westerly—to the right—toward Spica).

February 10: Venus is stationary relative to the stars. It now resumes its direct (easterly) motion, which has the effect of slowing the rate at which it separates to the sun's right. In the morning sky, Venus is rising in the east, quite bright, at dawn.

February 12–13: These are the nights to find Mars, Saturn, and Jupiter. There is a bright pointer in the sky near them, and you can't miss it—it's the moon. Look on the night of the 12th from moonrise (about 10 P.M. on) and you will see Mars, Saturn, and Spica just below the moon, and Jupiter to their east (left or below, depending on the time of night). Follow them during the night, and you will observe the moon slide slowly above them from right to left. Then look again on the night of the 13th, after moonrise at about 11 P.M. The moon will be above Jupiter (the brightest of the planets), with ruddy Mars (second brightest) well to the right (or higher), Saturn and Spica (the bright star of Virgo) in between. Mercury (also in the morning sky, but not so you would notice it) is stationary on the 12th, ending its retrograde (westerly) motion.

February 20: The morning sky is full of planets. The moon is the pointer for Venus today, low in the east at dawn, with the slim crescent pointing up at the bright planet well above it. Now place yourself with the moon and Venus on your left, and over to your right, still high above the horizon, you will find our good friends Jupiter (highest), Saturn and Spica (next lower and dimmest), and Mars (lowest).

February 21: It's Mars' turn to halt its usually easterly (direct) motion through the stars. Coming up to its opposition in late March, the planet now begins to move westerly (to the right), taking it away from the star Spica. At this position in its cycle of configurations relative to the earth, Mars brightens and rapidly becomes very prominent in the night sky.

February 24: Now it's Jupiter's turn to retrograde. Jupiter and Mars, the two bright planets near Spica, are now moving to the right (west) relative to Spica and the other stars. Watch them to see which moves more rapidly, which moves slower. Venus, the lonely morning planet in the direction of the sunrise (but easily the brightest), reaches its greatest brilliancy in the morning sky.

February 25: Saturn, moving retrograde, makes its second pass relative to Spica (going west, to the right, this time). Number one in this triple conjunction occurred on January 8; number three comes in September.

February 26: Mercury is at its greatest westerly elongation, the best place to see it as a morning star.

Editor's Note: The Celestial Events Sky Map in the January issue shows the evening constellations and stars for this month and gives the times for use.

The 1982 Program

Stimulate your mind on a Questers nature tour. We search out the plants and animals, birds and flowers... and explore rain forests, mountains and tundra, seashores, lakes and swamps. There is ample time to photograph, absorb, reflect. Naturalist guides, small tour parties, first-class accommodations.

Worldwide Nature Tours
1982 Departures

The Americas

Everglades: 11 days, Apr. 8, Nov 4 • **Hawaii:** 15 days, Feb. 14, Mar. 21, Oct. 10, Dec. 19 • **Alaska:** 17 days, June 12, 26, July 10, 24, Aug. 7 • **Pacific Northwest:** 12 days, June 20, Aug 1 • **Superior Forest Canoe Trip:** 9 days, July 10, Aug 14 • **Northwest Canada:** 16 days, July 2 • **Churchill:** 11 days, July 17 • **Newfoundland:** 16 days, June 13 • **Baja California:** 11 days, Apr. 16, Oct. 15 • **Southern Mexico:** 14 days, Feb. 14, Dec. 19 • **Costa Rica & Panama:** 16 days, Feb 13, Nov. 20, Dec. 18 • **The Amazon:** 17 days, Jan. 17, May 9, July 4, Aug. 8, Oct. 10, Nov. 14 • **Galapagos:** 15 days, Jan. 28, Apr. 22, July 15, Aug. 5, Oct. 28 • **Peru:** 23 days, July 17, Nov 6 • **Patagonia:** 21 days, Nov. 6 • **Trinidad & Tobago:** 11 days, Mar. 8, Nov. 8.

Europe

Iceland: 16 days, June 11, July 2, Aug. 6 • **Islands/Highlands of Scotland:** 21 days, May 27, July 15, Aug 19 • **Switzerland:** 17 days, July 16, Aug 13 • **Greece:** 19 days, Mar. 29, Sept. 20 • **Spain:** 20 days, Apr 16, Sept. 3.

Asia and Africa

Israel: 16 days, Mar. 15, Oct. 18 • **The Himalayas:** 23 days, Mar. 18, Oct. 7 • **India:** 23 days, Jan. 30, Oct 30, Nov 27 • **Sri Lanka:** 18 days, Feb. 19, Nov. 19 • **Kenya:** 23 days, Feb. 4, July 22, Oct. 21 • **Zimbabwe & Botswana:** 19 days, July 8, Aug 5.

Australasia

Australia & New Zealand: 30 days, Feb. 13, Oct. 2 • **New Zealand & the Milford Track:** 22 days, Feb. 12, Nov 12 • **The Complete Australia:** 35 days, Sept 3

To learn more, write requesting the 1982 Directory of Worldwide Nature Tours. Indicate if you are interested in any particular tour and we will send the corresponding Detailed Itinerary.

QUESTERS

Questers Tours & Travel, Inc.
Dept. NH, 257 Park Avenue South
New York, NY 10010 • (212) 673-3120

Now available with optional wooden floorboards!

The Quality Alternative to High-Cost Inflatable Boats!

Why pay $600. to $1000. or even more for an inflatable boat?
Sea Eagles pack small, last for years and cost $110. – $540.
Canoes, dinghies and motormount boats for fishing, river running, camping and yacht tending.

Sea Eagle 8, shown: • 9'7" x 4'6" • 31 lbs.
• Holds 4 adults • 3 hp capacity • Costs $220.

Write for our FREE brochure: Sea Eagle,
Dept. NH2B, St. James, NY 11780
Or phone:
516-724-8900, 8:30 AM to 4:30 PM EST.

SEA EAGLE

University of California
Research
Expeditions
Program

You could do something different this year!

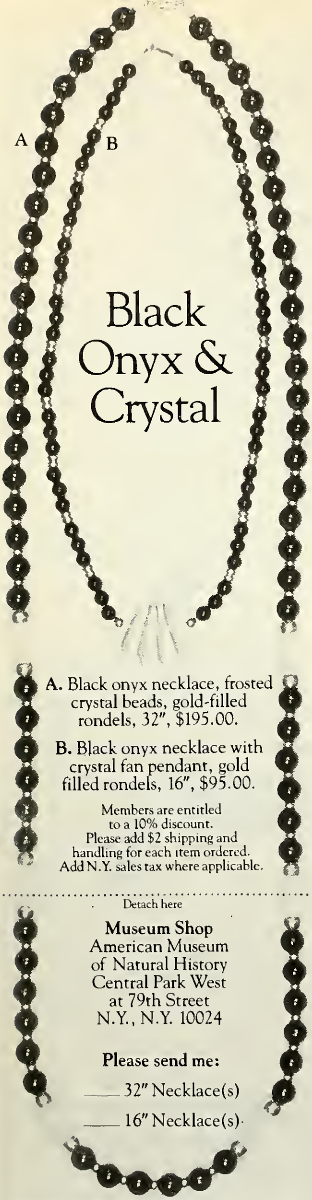
- Census forest monkeys in Kenya
- Discover dinosaur fossils in Nevada
- Survey endangered butterflies in California
- Study traditional agriculture in Mexico
- Observe solar activity in Brazil
- Collect forest plants in the Andes
- Explore the Great Barrier Reef in Australia

No previous experience necessary

Be an active member of a small field research team Your participation and tax deductible contribution make it possible

for brochure write

University Research Expeditions Program
University of California (UREP) Desk F
Berkeley, CA 94720 (415) 642 6586



Black Onyx & Crystal

A. Black onyx necklace, frosted crystal beads, gold-filled rondels, 32″, $195.00.

B. Black onyx necklace with crystal fan pendant, gold filled rondels, 16″, $95.00.

Members are entitled to a 10% discount.
Please add $2 shipping and handling for each item ordered.
Add N.Y. sales tax where applicable.

Detach here

Museum Shop
American Museum
of Natural History
Central Park West
at 79th Street
N.Y., N.Y. 10024

Please send me:

____ 32″ Necklace(s)

____ 16″ Necklace(s)

I enclose a check payable to the American Museum of Natural History for $________.

Charge to ☐ Visa ☐ MasterCharge

Account # Exp. date

Signature (if using credit card)

Name

Address

City State Zip

Evolutionary Housecleaning

by Niles Eldredge

THE NEW EVOLUTIONARY TIMETABLE, by Steven M. Stanley. *Basic Books, $16.75; 222 pp., illus.*

Not usually the stuff of headlines, evolution has been getting a lot of press lately. Two separate factors have coincidentally conspired to bring one of biology's older and usually quieter sides into the limelight. The more obvious impetus toward notoriety comes from the meteoric rise of creationism: fundamentalist Christians have recently succeeded once again in making evolution a public issue. The zeal underlying their success springs from a deeply felt conviction that the view of man as a direct genealogical descendant of lower beasts spawns a materialistic, antireligious ethic. Teaching evolution is responsible, according to creationists, for the rise in crime and general moral decay. Not since the early days following the appearance of Darwin's *On the Origin of Species* (1859) has evolution commanded so much attention—although much of the interest lies in its supposed ethical implications rather than in what evolution has to say about how the biotic realm came to be as we see it today.

But, I am glad to say, not entirely lost in the shuffle is a second phenomenon: evolution has also attracted attention, both within science and without, on its own mettle. For, quite apart from creationist ravings, evolutionary biologists of diverse stripe have been actively engaged in their first intellectual housecleaning in fifty years. Whether the result will be the spectacular refurbishing of our notions of how life evolves—as Steven Stanley thinks in *The New Evolutionary Timetable*—or the mere racking off of old wine into new bottles, as a determined number of evolutionists (still in the majority) firmly believe, is very much up in the air. Whatever the outcome, the doubt that has infiltrated the previous, smugly confident certitude of evolutionary biology's last twenty years has inflamed passions and provoked some very interesting thought and research. In short, evolutionary biology has entered a phase of creativity that is the hallmark of good, active science.

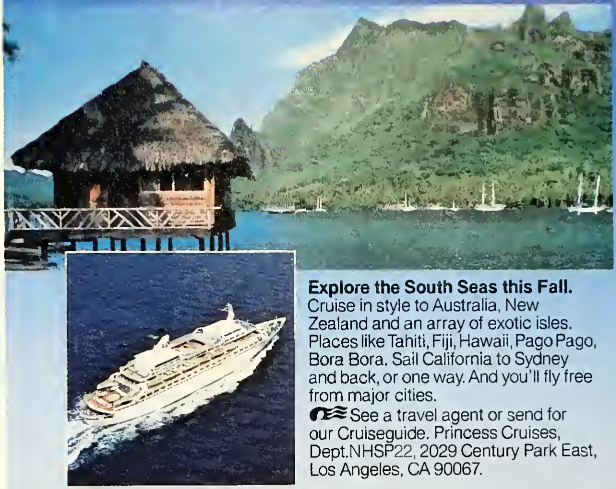
Just over a year ago, some 150 biologists met for three days in Chicago's Field Museum of Natural History to discuss the current status of evolutionary theory. All of a sudden, the in-house wrangling went public—fueled, no doubt, by creationist activities, but provoking widespread interest in its own right. Although arguments among scientists sometimes do command ink in the popular press, I have to agree with Norman MacBeth (a lawyer and biology watcher) that evolutionists have for too long effectively concealed the debates that have always lain just beneath the surface of their topic. It is high time that the public be given an accurate view of how science works as a self-correcting system, essentially a marketplace of competitive ideas. We need, in short, to be open about exactly what is going on these days in evolutionary biology.

Thus Stanley's book is most welcome. Although there are at least ten books by evolutionists in the works that specifically take up the cudgels against creationism, there has been a dearth of readily accessible statements about evolution's own intrinsic ferment—nothing, in short, to point to when someone asks "What can I read that will make this all clear?" Although not an unequivocal success, on the whole *The New Evolutionary Timetable* succeeds admirably in developing one of the several new wrinkles in evolutionary thought. Stanley effectively contrasts the heretical with the more traditional lines of thought, and there is little likelihood that a serious reader, determined to understand what's new, will come away from this book confused.

Stanley's book, essentially a distillation of his much more technical book *Macroevolution* (1979), is a working statement of an alternative way of looking at patterns of evolution and how they are produced. Virtually all the major ideas of the earlier book reappear in the present effort, and both works develop (in addition to an overall view of evolution) summaries of most of the author's own particular contributions of recent years, on such diverse topics as the origin and significance of sex, the importance of predation in triggering biological diversity, and aspects of the notion of "species selection."

Stanley is a "punctuationalist." This rather inelegant epithet refers to a small (but growing) cadre of paleontologists who maintain that anatomical change in evolution is episodic and not the smoothly progressive and gradual affair that Darwin and his more orthodox descendants to the present day would have it. The core observation that once most species show up in the fossil record they exhibit hardly any change at all—not uncommonly remaining essentially static for millions of years—was made 150 years ago and was known to Darwin, but little was made of it until comparatively recently. Darwin blamed the scarcity of examples of gradual change in the fossil record on that record's notorious incompleteness. The fault, he felt sure, was the fossils'—or, rather, the lack of them—and not the details of his theory. Today, some 120-odd years later, the fossil record is in many instances good enough to give us an accurate picture of the geometry of evolution. And to many paleontologists, this geometry seems to be predominantly one of static nonchange "punctuated," as it were, by brief periods of rapid change. ("Brief," in geological parlance, can amount to as much as several tens of thousands of years.)

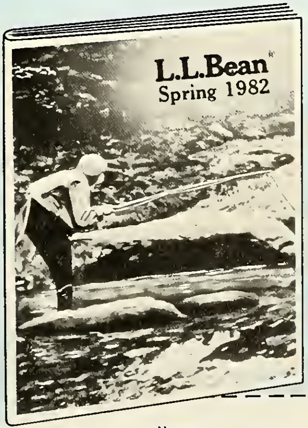
Geneticists these days are beginning to take an interest in this nonchange—a pattern that seems so unexpected. But with the benefit of 20/20 hindsight, it now seems obvious that there never really was any particular *biological* reason for Darwin or any of his successors to demand of evolution that it always (or even usually) proceed in a slow, steady progressive manner. Gradual change is a notion that seems to have taken root in science from Descartes's vision of a universe constantly in motion. And surely the notion of progress, especially of a



PRINCESS CRUISES
The Magnificent Adventure

Explore the South Seas this Fall.
Cruise in style to Australia, New Zealand and an array of exotic isles. Places like Tahiti, Fiji, Hawaii, Pago Pago, Bora Bora. Sail California to Sydney and back, or one way. And you'll fly free from major cities.
See a travel agent or send for our Cruiseguide. Princess Cruises, Dept.NHSP22, 2029 Century Park East, Los Angeles, CA 90067.

South Pacific · Alaska · Transcanal · Mexican Riviera · Caribbean



L.L.Bean®
Outdoor Sporting Specialties

FREE
Spring Catalog

Fully illustrated. Features quality apparel and footwear for men, women and children; fishing, hiking, camping and canoeing gear. For 70 years L. L. Bean has offered practical and functional merchandise at reasonable prices. Our clothing and footwear is rugged enough to withstand active outdoor use, yet attractively styled and comfortable for casual wear. Many items are of our own manufacture. All fully guaranteed.

☐ SEND FREE CATALOG

Name__________
Address__________
City__________
State______ Zip______

L. L. Bean, Inc., 701 Casco St., Freeport, ME 04033

Nat. History Feb.

GET UP TO 33% OFF
WHEN YOU ASK FOR
MORE ALASKA

Cruise the Inside Passage with TravAlaska and save up to 33% by choosing the economical Alaska Ferry. Or experience the luxury of a cruise ship or new mini-cruiser. And for the first time, you can choose a dollar-stretcher itinerary that shows you the Best of Alaska *and* the Canadian Rockies in one scenery-packed trip.

TravAlaska Tours
Fourth & Battery Bldg., Suite 555
Seattle, WA 98121

Please send me your free brochure on NH2
Alaska and the Canadian Rockies
Name ______
Address ______
City ______
State ______ Zip ______

TravAlaska
YOU CAN'T ASK FOR MORE ALASKA THAN TRAVALASKA

This distinctive, individually, handmade lion head plaque, framed by an intricate border, can now be yours for only $125.00 post paid. No two exactly alike. Your choice of woodstain; cherry, oak or mahogany.

Size:
15"x15"

Include name and address with your check or money order. Allow 4-6 weeks for delivery. No C.O.D.'S

UNLIMITED
SPECIAL EFFECTS, INC.
3807 N. LINCOLN AVE. CHICAGO, IL. 60613
TEL: (312) 549-5955

Thirty miles north of Tahiti is the most beautiful and also the only completely unspoiled coral island of French Polynesia, once the summer resort of the Tahitian royal family. This gem is

TETIAROA

and is now owned by Mr. Marlon Brando, who has created a bird sanctuary, a centre for atoll research, and a traditional Tahitian village with accommodations for discriminating guests who are willing to forego luxurious amenities in order to enjoy unrivaled quiet and tranquility.

Having stayed on Tetiaroa and relaxed there as nowhere else, and been welcomed by its manager, the lovely Tarita, and her family and staff, we highly recommend a visit to this unique, private paradise.

Detailed brochures of our ten-day independent tour to Tetiaroa are available from:

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

stately, orderly, and gradual kind, was rampant in nineteenth-century Europe. Now, ten years after the "punctuational model" had its current rebirth, evolutionary rates might simply be acknowledged as episodic. After all, as the many defenders of orthodoxy loudly proclaim, no one ever thought that all rates of evolutionary change were constant. Now we admit that evolution is more of a fits-and-starts affair than we used to think. This hardly seems to be the stuff of revolution.

If punctuationalism were merely a debate about rates of anatomical change, the observation of stasis could easily be encompassed by the prevailing theory of how evolution works: the so-called modern synthesis. This synthesis is so named because it represents a resolution of conflicts in various branches of genetics in the late 1920s and early 1930s, and a consequent reconciliation of a newly unified genetics with the data of paleontology and systematics (the study of relationships among organisms and their classification). In essence, the synthesis—a simple, logical, and compellingly elegant formulation—sees natural selection working on the variation in each generation within a population, favoring only those individuals best suited to coping with life's exigencies. The ultimate source of this variation is mutation, but normal processes of genetic shuffling are responsible for the expression of each generation's pattern of variation.

Natural selection is "differential reproductive success": individuals most adept at life tend to leave more offspring in the next generation. Thus, if the environment remains constant, so will a species, although perhaps it will gradually become more nearly perfect as the years go by. But if the environment should change, so will a species, playing the adaptive equivalent of catch-up football with the ever fickle habitat.

Most punctuationalists have little difficulty accepting the Neo-Darwinian paradigm of genetic change. As Stanley points out, the prevalence of nonchange in the fossil record calls the general assumption of all-pervasive continual adaptive transformation into question, but this is not enough to challenge the synthesis. Punctuationalism is also a debate about *how* change occurs, however, and the synthesis says one more very important thing: *all* evolutionary patterns are produced by this simple mechanism of generation-by-generation change. The fundamental problems in reconciling this point of view with a herky-jerky pace of evolutionary change become clear if we consider large-scale evolutionary phenomena—for example, the progressive increase in brain size within our own human evolutionary lineage—which the synthesis (and most paleontologists) ascribes simply to adaptation through natural selection.

Consider evolutionary trends: the fossil record of human evolution over the past four million years shows a definite, progressive increase in overall body size and in both relative and absolute size of our brain. Yet each of the nine or so species of fossil hominids exhibits internal stability in these features throughout its geological time span. The best example is *Homo erectus*, the erstwhile Peking and Java Man, now known from Africa and Europe as well. This species, along with its definitive stone-tool culture, persisted virtually unchanged from roughly 1.5 million to 200,000 years ago—a period of some 1.3 million years. If, as seems reasonable, increase in brain size implies higher intelligence and is thus a desideratum, adaptively speaking, we are faced with something of a paradox: why didn't natural selection work continually to increase brain size? The synthesis has to explain trends through geological time as though they were merely animal breeder's experiments (such as artificial selection for increased milk production in cows) performed over the vastly longer periods of thousands and millions of years. How, then, could *Homo erectus* remain stable for so long if an increase in brain size is so adaptively important? Why, if an ever enlarged brain is so important to the occupation of the human niche, does our increase in braininess form a pattern of episodic change?

The synthesis sheds no light on this paradox but punctuationalists offer a solution that is deceptively simple. In the words of biologist Michael Ghiselin, species are *individuals*: as finite reproductive communities composed of lower-level individuals (that is, individuals in the conventional sense of the term), species have origins, histories, and (inevitably) terminations. The fossil record indicates that species change very little, but in the larger context of change within an entire lineage of many species, it is individual species, not just individual organisms, that display a pattern of differential success. Punctuationalists think we owe our braininess, at least in part, to the long-term greater success of those hominid species whose members had the larger brains at any one point in time. This is, broadly speaking, what punctuationalists mean by "species selection."

Species selection—a culling process among species—is *not* an alternative to pure natural selection, which is a culling process of individual organisms *within* species. Rather, the argument is additive: pure natural selection cannot alone account for all aspects of the grosser patterns of evolution. But most punctuationalists, certainly including Stanley, agree that natural selection is the most important mechanism underlying genetic and anatomical change—when that change occurs. Most such change appears to be related to the process of budding off a new species from an ancestral species.

That's what's new—the possibility that evolution is a bit more complex than the synthesis would have it. Stanley sets forth all this and more in workmanlike fashion. In places his argument may be a bit too densely stated for the tastes of an uninitiate, but a saving grace comes from his liberal use of examples from the natural world.

I disagree with some of Stanley's biology: his notion of "chronospecies" is inconsistent with the view that species are individuals, and his ideas on "quantum speciation" strike me as in some ways extreme. I mention this only to illustrate the lack of total agreement even within the warring camps: things really are in an uproar these days, and each of the "basic" ways of looking at evolution has its minor variants. Sometimes it seems as though there are as many variations on each theme as there are individual biologists. But that's as it should be; this is how science is supposed to operate. Creationists say the ferment reveals evolution's weakness: even the professionals cannot agree on how evolution works! But this is a canard that illustrates the very real threat creationists pose. When they misrepresent the exuberant, creative doubt and controversy permeating evolutionary biology these days, they are actively promoting scientific illiteracy. If we are to integrate science and its satellite technologies more effectively with society as a whole, we need less, not more, of such illiteracy. I hope Stanley's book will redress the balance a bit. We need all the help we can get.

Niles Eldredge is a curator in the Department of Invertebrates at the American Museum. He is the author of The Monkey Business *and coauthor of* The Myths of Human Evolution, *both of which will appear in the spring.*

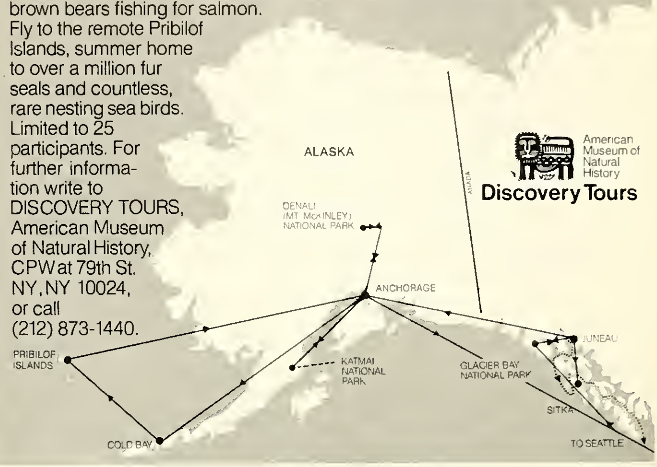
ALASKAN WILDLIFE ADVENTURE

June 25 to July 12, 1982

Join Kenneth A.Chambers, Lecturer in Zoology at the American Museum, for a journey to America's last great frontier. Cruise through fabulous Glacier Bay with its whales, seals and teeming birdlife. Explore scenic Denali (Mt. McKinley) National Park and see giant moose, white mountain sheep, barrenground caribou, and golden eagles. Visit volcanic Katmai and watch brown bears fishing for salmon.

Fly to the remote Pribilof Islands, summer home to over a million fur seals and countless, rare nesting sea birds. Limited to 25 participants. For further information write to
DISCOVERY TOURS,
American Museum
of Natural History,
CPW at 79th St.
NY, NY 10024,
or call
(212) 873-1440.

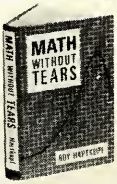
American Museum of Natural History
Discovery Tours



Brodrick's
Tool and Hobby catalog

A unique collection of quality tools for woodworking, home repairs, gardening, and workshop. Special selections of hobby tools and kits & pre-packaged wood, oak and maple furnishings, fine gifts and more. From BRODHEAD-GARRETT, prime manufacturer/distributor since 1903. Limited Copies.
To reserve your FREE CATALOG, write or call
TOLL-FREE **800-321-6730**
(in Ohio: 800-362-8195)
Brodrick's Dept. 110, 4560 E. 71st St.
Cleveland, Ohio 44105

MATH WITHOUT TEARS



Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written.
Learn math in the comfort of your own home at minimum cost.

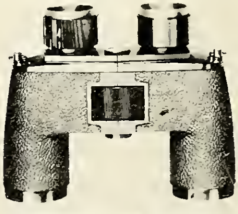
Order Now $10.95 plus $1.25 hdlg
EMERSON BOOKS, INC.
Dept. 314-G, Verplanck, NY
10596
10 Day Money Back Guarantee

Crossroads of Evolution
Galapagos

Cruise Darwin's "enchanted island" by private yacht. Photograph unusual wildlife. Enjoy stimulating lectures by naturalist/guides. Visit artistic Cuenca on mainland Ecuador. 15 days.
Write for details.

Society Expeditions
Dept. NH-10
723 Broadway East.
Seattle, WA 98102

Name
Street
City / State / Zip
Please Include: ☐ New Guinea ☐ Galapagos ☐ Mongolia ☐ Tunisia ☐ Antarctica ☐ Amazon ☐ New Guinea & Melanesia ☐ New Guinea & Indonesia ☐ Singapore to Seychelles ☐ Arabia ☐ Iceland & Greenland ☐ N. & West Africa ☐ China



BUSHNELL 7x35 CUSTOM
Mfg. List $280.00 Postpaid $164.00
This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.
GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

Better Than Jogging

NordicTrack

Jarless Total Body Cardiovascular Exerciser

Duplicates X-C Skiing for the Best Motion in Fitness

Highly Effective and Pleasant To Use
The enjoyable sport of cross-country skiing is often cited as the most perfect form of cardiovascular exercise for both men and women. Its smooth, fluid, total body motion uniformly exercises more muscles and higher heart rates seem easier to attain than when jogging or cycling. NordicTrack closely simulates the same pleasant motion and provides the same cardiovascular endurance-building benefits — right in the convenience of your home. Makes a year round, consistent exercise program easily attainable. Eliminates the usual barriers of time, weather, chance of injury, etc. Also highly effective for weight control.

Better Than Running
NordicTrack gives you a more complete work out — conditions both upper body and lower body muscles at the same time. Fluid, jarless motion will not cause joint or back pains as jogging or running often does.

Better Than Exercise Bikes
NordicTracks stand-up skiing motion more uniformly exercises large leg muscles and also adds important upper body exercise. Higher pulse rates, necessary for building fitness, seem easier to attain because the work is shared by more muscle mass. The NordicTrack also keeps more muscles in tone.

Even Better Than Swimming
NordicTrack more effectively exercises the largest muscles in the body, those located in the legs and buttocks. These muscles main function is to lift and propel the body in the standing position. When swimming, the water supports the body thus preventing these muscles from being exercised as effectively as when they support the body in a standing position as when using the NordicTrack.

A Proven, high Quality Durable Product
Ruggedly constructed, NordicTrack is quiet, motorless and folds compactly for storage. Separate arm and leg resistances. NordicTrack is in its 5th year of production and is used in thousands of homes and many companies. We manufacture and sell direct. Our No-Risk 15 day trial guarantee shows our confidence in your being pleased with the performance and quality of the NordicTrack.

For more information, call or write
PSI 124 L Columbia ct. Chaska, MN 55318
toll free 1-800-328-5888 8 - 5 Mon - Fri
Minnesota 612-448-6987

Quakes on the Moon

Most moonquakes differ in significant ways from earthquakes

by Stephen P. Maran

Geologists may lack a proven way to predict earthquakes, but lunar scientists have learned when to expect some quakes on the moon. This is a case in which our knowledge of another world is superior to our understanding of the earth. Much of what we know about the earth's interior was learned from earthquakes. Therefore, studies of quakes were included in the Apollo program of manned lunar landings in order to determine the internal structure of the moon. Earthquakes have been routinely and accurately measured for years, but moonquakes were recorded for the first time during an eight-year period from 1969 to 1977, beginning with the first Apollo moon landing. A recent study made by three seismologists shows that most of the moonquakes recorded then were about 100 times more powerful than was previously believed.

A moonquake, as the term suggests, is a lunar version of an earthquake. It is a disturbance on or inside the body of the moon that manifests itself as a seismic wave, or vibration, on the surface. Prior to July 1969 no one knew if there were quakes on the moon and probably few people cared. On July 24 of that year, however, Apollo 11 astronauts, Neil Armstrong and Buzz Aldrin, landed their lunar module, the *Eagle*, at Tranquillity Base. During the astronauts' brief stay on the moon, they set up a small seismic station, which operated for three weeks and detected many disturbances. Most of them were caused by hissings and cracklings in the equipment the astronauts left behind on the moon, including part of their spacecraft. Other vibrations seemed to be true natural phenomena of the moon. But the main lesson learned was that future visitors should set up their seismic stations well away from the lunar modules.

On November 19, 1969, Apollo 12 astronauts Pete Conrad and Alan Bean installed the first of what were to be four long-lived seismic stations on the lunar surface. (The others were set up during the Apollo 14, 15, and 16 missions.) The Apollo 12 seismic equipment was located about 430 feet from the lunar module *Intrepid* and promptly showed that it was functioning well as it recorded each step the two astronauts took on the moon. Within a day, however, the instruments made a more dramatic observation. On November 20, a discarded spacecraft system, the lunar module ascent stage, crashed on the moon about fifty miles from the station. This event, which equaled in force the explosion of 1,770 pounds of TNT, set off a remarkable vibration of the lunar surface that persisted for at least an hour. The seismic station measured the pattern of vibration, providing seismologists with the characteristic "signature" of an impact moonquake—a quake triggered by a falling object. Armed with this signature, the investigators were able to recognize the much weaker vibrations caused as small meteoroids fell to the moon during the eight years that the Apollo monitoring stations recorded moonquakes.

Prior to the Apollo studies some lunar experts thought that the moon might be seismically noisy, shaking with the discordant vibrations of tens of thousands of rock surfaces. This effect, they believed, would result from the continual heating and cooling of the surface rocks that accompanies day and night on the moon. The rocks go from about the boiling point of water at lunar noon to far below freezing shortly after sunset, and then heat up again at dawn. Lunar scientists feared that rock vibrations induced by this temperature cycling would mask the more interesting seismic waves from events deep inside the moon, the so-called intrinsic moonquakes. This thesis, however, proved wrong. The seismic station measurements showed that the moon is so quiet that quakes far weaker than any detected on the earth can be recorded, even those that shake the lunar surface back and forth by a mere twelve-billionths of an inch. Weak moonquakes of the intrinsic type were detected in still greater numbers than those caused by the rain of meteoroids from space.

The intrinsic moonquakes revealed a type of seismic activity that is strikingly different from that found on the earth. The differences include the locations, depths, repetition characteristics, and intensities of quakes. The most notable difference is that earthquakes seem to occur in a systematic pattern of locations, but with no systematic trend in time. By contrast, moonquakes show no orderly pattern of locations, but many occur with roughly predictable timing.

On the earth, most quakes occur in the narrow belts marking the boundaries between the slowly moving plates of rock involved in continental drift. As the huge plates slide past each other, collide, or draw apart, they create enormous stresses that induce earthquakes. Although quakes occur over and over again in the active belts—for example, along the San Andreas fault in California—they do not often repeat at identical foci, or points of origin, and the foci of the thousands of observed earthquakes are nearly all less than 450 miles below ground.

On the moon, more than 90 percent of the intrinsic quakes recorded by the Apollo seismic stations occurred at only about 100 foci, all deeper than 450 miles and located in a zone extending down to about 700 miles below the surface, or halfway to the center of the moon. These so-called deep moonquake foci are not arranged along narrow belts or in any other recognizable pattern. Unlike earthquakes, the deep moonquakes recur regularly at the same foci and the quakes from a given focus display a characteristic vibration pattern that identifies the focus the way fingerprints identify an individual. Thus, whatever event causes a deep moonquake occurs repeatedly in just the same way.

The deep moonquakes were found to occur predominantly at intervals of

NORTH
CAROLINA

Look Before You Leave.

The North Carolina Travel Package is an award-winning collection of information to help you plan your vacation.

You get facts on where to go, where to stay, and what to do. Even a full-color map that's keyed to points of interest. And it's all free. Just send us the coupon.

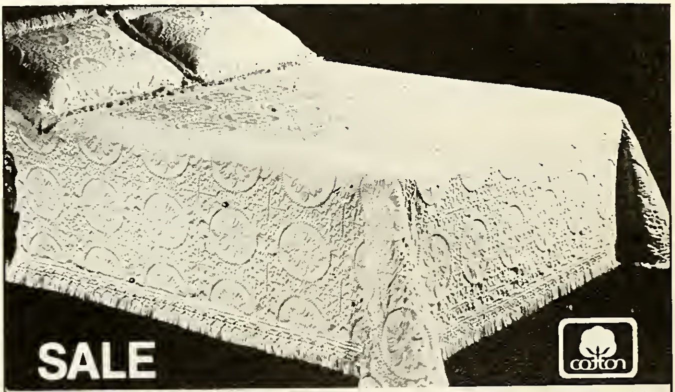
After all, even if you want your vacation to be an adventure, there are some things you don't want to be adventurous about.

Name ____________ Address ____________

City ____________ State ______ Zip ______

NORTH CAROLINA TRAVEL PACKAGE

North Carolina Travel, Department 157, Raleigh, North Carolina 27699.



Beautiful Early American
"COLONIAL LOFT"
BEDSPREADS

- Heavy—soft—durable
- 100% Quality Cotton
- Machine washable
- Choose white or natural
- Special Prices:

Twin 80 × 110, value $40...... only $32.95
Full 96 × 110, value $50 .... only $39.95
Queen 102 × 120, value $65 . only $47.95
King 120 × 120, value $75 .... only $55.95
Sham (standard), value $15 ...only $11.95 ea
Add $2.50 per order for shipping

100% Natural Cotton, soft but ever so durable. A true legacy of Early America. This elegant woven bedspread is fully pre-shrunk and machine washable, with no ironing ever. Rich, full, all-cotton decorator fringe. **Guaranteed.** We ship fast.

Homespun Crafts • Dept. NH-3, Box 1776
Blacksburg, S.C. 29702

Gentlemen: Please rush ____________ "Colonial Loft"
______ Size spreads & ______ shams, color ____________
☐ Check ☐ M.O. enclosed ☐ M.C. ☐ Visa
Credit Card No. ____________ Exp. Dt. ______
Name ____________
Address ____________
City ____________ State ______ Zip ______
M/C, VISA orders—call Toll Free 24 hrs.: 800-438-7939, ext. NH-3
In N.C., dial 800-458-3491, ext. 86-A. Call Now!

ARAB
CAPITAL
AVAILABLE

We have a list of potential clients from all over the Arab world who have shown interest in promoting, funding, buying and investing in all sorts of real estate projects, or any other worthwhile profit-making venture in North America. We will send you this very select list for $190.

IAAIC
8306 Wilshire
Blvd. Suite 198
Beverly Hills,
CA 90211

Satisfaction guaranteed
or money refunded

twenty-seven days, a figure that equals the period of the moon's orbit around the earth. This was the telltale clue that deep moonquakes are actually triggered by the earth. The earth raises tides in the solid body of the moon that are strongest once each twenty-seven days when the moon passes through perigee, its closest point of approach to the earth. On the earth, the most visible consequence of the moon's tidal force is, of course, the ocean tides. But in the moon, which lacks any kind of ocean, the tides due to the earth produce their only observable consequence in the form of the deep moonquakes. No one knows what unusual characteristics produce a deep moonquake focus. Perhaps the foci are locations of structural weaknesses in the moon.

Shallow moonquakes are the rarest of lunar quakes. Only twenty-eight such events were recorded during the eight years of moonquake observations that ended on October 1, 1977, when owing to budgetary limitations, NASA controllers ceased recording radio signals from the Apollo seismic stations. The shallow quakes, as you will already have guessed, have foci at lesser depths than the deep moonquakes. To our knowledge they are also the most powerful seismic disturbances on the moon and the only type of moonquake with a known counterpart on the earth. According to Yosio Nakamura, an authority on earthquakes and moonquakes at the Marine Science Institute of the University of Texas, in Galveston, the shallow moonquakes resemble a relatively rare type of earthquake known as an intraplate earthquake, and may result from a similar cause.

Intraplate earthquakes are those that take place at some distance from the narrow belts where most quakes occur. On rare occasions, these events shook such normally placid towns as Charleston, South Carolina, and New Madrid, Missouri, as though they had been built over the worst fault in California. The intraplate quakes are thought to occur at foci that mark weak spots in the interiors of plates—hence the term *intraplate*. In 1980, Nakamura proposed that shallow moonquakes represent a similar phenomenon, and he pointed out that their foci lie below the huge impact basins of the moon, the scars of ancient collisions with great meteoroids and asteroids. Such basins may also be weaker than their surroundings.

The recent study mentioned at the outset of this column was a reevaluation of the release of seismic energy on the moon done by seismologists Neal R. Goins of the Mobil Research and Development Corporation, Anton M. Dainty of the Georgia Institute of Technology, and M. Nafi Toksöz of the Massachusetts Institute of Technology. They reported in January 1981 that previous estimates of the energies involved in intrinsic moonquakes were too low by a factor of about 100. According to the team, the earlier estimates did not take proper account of the instrumental sensitivity of the seismic stations and also overlooked an important effect on the moon. The surface layer of the moon is very inhomogeneous, consisting of much compacted rubble with many large and small boulders jumbled together. This feature has presumably resulted from the destructive impacts of large meteoroids over millions and billions of years. Seismic waves tend to bounce back and forth among these inhomogeneities, losing energy and fading on their way from the moonquake focus to the nearest monitoring station. This makes a seismic vibration seem weaker than it should be for a moonquake of a given strength. Taken together with the above-mentioned corrections for instrumental sensitivity, the bouncing and fading effect accounts for the upward reevaluation of the energies of intrinsic moonquakes made by Goins and his coworkers. The estimates of the energies of impact moonquakes should not be affected by this process, Toksöz told me recently, because they were determined through the observation of quakes from the impact of the Apollo 12 lunar module ascent stage and other spacecraft of known masses and impact velocities.

Even with the upward adjustment of moonquake energies, the moon seems like a pretty good place to build a vacation cabin if thoughts of falling meteoroids don't bother you and you can ignore the lack of air, water, and cultural amenities. There are no taxes or noisy neighbors, so it should be possible to get away from it all. As far as we know, you won't ever feel a moonquake, even at high tide, for the vibrations are too weak. The total energy released in all the moonquakes recorded during the eight years of Apollo monitoring was about sixty million times less than the energy of the great Chilean earthquake of 1960. On the other hand, Nakamura has pointed out that since we have not observed many shallow moonquakes, we don't know the frequencies of shallow moonquakes of various strengths very well. None of the twenty-eight observed shallow moonquakes was strong by earthquake standards, but maybe one in a few hundred, or one in thousands, is a great disturbance. There even is a rationale for this possibility.

On the earth, the lithosphere, or layer of solid rock, lies just above a layer of hot, soft, and semiliquid rock. A lithospheric plate that extends horizontally for thousands of miles may be only forty-five miles thick. This relative lithospheric thinness may be what has allowed that terrestrial layer to fragment into individual drifting plates. On the other hand, since the moon is so much smaller than the earth, it has cooled more rapidly, and thus its cool, solid lithosphere is much thicker. Perhaps 600 miles deep, the lunar lithosphere may store up what would, by earthly standards, be enormous stresses if it is subject to internal forces. Should some event ever release these stresses, it might cause the granddaddy of all moonquakes, which could rival or exceed major quakes on the earth.

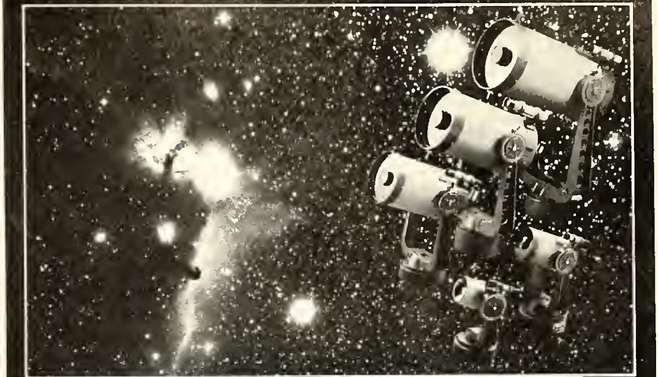
Despite their obvious differences from seismic activity on the earth, moonquakes have much to teach us that may be applicable to our own planet. Some day eons hence, the gradual cooling of the earth's interior will allow the lithosphere to thicken, and the drifting plates will come to a halt. Earthquake processes may then, perhaps, begin to resemble the shallow moonquakes that we now observe and that are also similar to the occasional intraplate earthquake. The earth may now have tidal earthquakes, but they are too weak to detect with certainty amidst the noise of other earth vibrations. To understand the tidal quake phenomenon, therefore, we have to study lunar data. But, unfortunately, the measurements of lunar quakes came to a halt more than four years ago.

In sum, we are still on shaky ground (if you will permit me that metaphor) in evaluating the seismic phenomena of the moon. Intrinsic moonquakes are apparently 100 times stronger than was thought only a few years ago, and the most powerful ones may be so rare that none occurred during the eight years that scientists were listening. No lunar research station is currently active, and at present there are no firm plans for a moon visit in the forseeable future. For U.S. seismologists, the motto is still, "California, here I come."

Stephen P. Maran is a senior staff scientist in the Laboratory for Astronomy and Solar Physics at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

Telescopes from Celestron® They Can Take You Places You've Never Seen Before

Photographic and Visual Capabilities



Shown are five of Celestron's telescopes on a background photographed through a Celestron Instrument. Available At Your Local Camera Outlet.

With a Celestron, the modern standard of high quality, affordable telescope performance, you can explore the craters of the Moon, the rings of Saturn, twirling galaxies and glowing nebulae. You may use a Celestron to photograph and view terrestrial subjects.

All Celestron telescopes have laser-tested, diffraction limited optical systems with hand-figured optics made in the U.S.A.

Celestrons® are available from [illegible]2- to 14-inches in diameter including the world's most popular modern telescope, the versatile Celestron [illegible]. And, remember, most 35mm cameras easily attach to the Celestron for photography.

Free 8-page brochure or send $3.00 for 52-page full-color catalog.

Celestron International **New dealer inquiries invited.**
2835 Columbia St., (Box 3578-NH2), Torrance, CA 90503, U.S.A. Telephone: (213) 328-9560

American Museum of Natural History
Discovery Tours

GALAPAGOS ISLANDS CRUISE

June 5-17, 1982

Discover a naturalist's paradise: a volcanic archipelago straddling the equator and home to unique and tame animals. Share a relaxed holiday aboard the comfortable M.V. Buccaneer with three American Museum curators—all experts in their fields; ornithology/ecology, geology/volcanology, herpetology/evolution. Enjoy superb climate, sandy beaches, fantastic photographic opportunities, and good company. Limited to 65 passengers. For further information write to DISCOVERY TOURS, American Museum of Natural History, Central Park West at 79th Street, New York, NY 10024, or call (212) 873-1440.

THE MARKET

Art

AMERICAN INDIAN CRAFTS: Southwest Indian pottery, baskets, rugs, kachinas. Northwest Coast Indian masks, totems, graphics. Eskimo sculpture. No catalog. One-of-a-kind pieces, individually photographed priced $100/up. Photos and data available. Specify interests. Box 5896. Sherman Oaks, CA 91413. (213) 789-2559

AUDUBON PRINTS, original handcolored birds and animals. Write Audubon, 9720 Spring Ridge Lane, Vienna, VA 22180

IROQUOIS WOLF FALSE FACE, 14″, $90, request photo, other masks available, McCoy Imports, Liberty, NY 12754

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHN, 84 Fifth Avenue, New York, NY 10011.

Books

ADVENTURE TRAVELING? Send 50¢ for free catalog of international travel guidebooks and maps in stock. Bradt, 54 Dudley St., Cambridge, MA 02140. Tel: 617-492-8776

BOOKFINDING. Librarians search worldwide titles or subjects plus 150,000 indexed stock. PAB, 2918 Atlantic, Atlantic City, NJ 08401 (609) 344-1943

FOLLOWING THE FOOTSTEPS OF STEPHENS-CATHERWOOD. Their 1840 Mexican travels! Original drawings/new photography. English/Spanish. 273 illustrations. Hardback. $20. Bernardo's, 2400 Westheimer, Houston, Texas 77098

NEW BOOKS REVIEWED. Know what's available before you buy. Latest natural history books, especially wildlife, thoroughly reviewed by scientists in "Fauna." Current issue $3. Fauna Society, Box 895, Rancho Mirage, CA 92270.

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalogue: Hamilton's, 98-55 Clapboard, Danbury, CT 06810

REFLEXIONS IN AN HERB GARDEN. Don and Barbara Harris. Informal essays on plants and animals; cooperations, competitions, recent thought on form and function in synecology. Great reading. Amphora Press, Box N, Groton CT 06340. 243 pp. $7.95 postpaid.

Camps

PRAIRIE TREK (Boys 13-17)—Turquoise Trail (Girls 13-17)—Little Outfit (Boys 10-12). Since 1926 these expeditions have made it possible for young people to explore in the mountains, canyons, and desert country of the American Southwest. Emphasis on environmental studies, archaeology, native crafts, backpacking and camping skills. For details write: Thomas M. Billings, P.O. Box 4045 1NH, Indianapolis, IN 46240 (317) 896-3842

Collectors' Items

NATURAL HISTORY POSTAGE STAMPS. Colorful collectibles. Samples, approvals $1. MilMed, Box 297H, Aurora, CO 80040

RECEIVE VALUABLE MINERALS MONTHLY! Free Details! Write Today! Mineral of the Month Club, 13057-H29 California, Yucaipa, Ca. 92399

Correspondence

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin, West Germany.

PENFRIENDS-ENGLAND-USA. Make lasting friendships through correspondence. Send age, interests. Free reply. Harmony, Box 89NH, Brooklyn, NY 11235

Education

ARCHEOLOGICAL FIELD SCHOOL—8 week field school in archeological excavation on a Western Anasazi site in southwestern Utah. June 14 to August 7. No previous experience required 15 quarter credits. Non-credit participation by adult avocational archeologists open for 2 to 8 week periods. Total enrollment limited to 20. For cost information write to Dr. Richard A. Thompson, Southern Utah State College, Cedar City, Utah 84720.

EXPLORE MICROSCOPIC WORLD—algae, zooplankton, protozoans, tissues, etc. New Science Courses for all ages. A guide to selecting and operating a microscope with free brochure. Life Sciences, Box 591-BC, Woodbury, NJ 08096

STUDY BACK-STRAP WEAVING this summer in Otavalo, Ecuador with the Tahuantinsuyo Weaving Workshops. Two week sessions July and August. Write: Wilderness Travel 1760-CW Solano Ave., Berkeley, CA 94707

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest handbook, $2.00 (guaranteed). Australian International, Box 19107-RM, Washington, DC 20036.

AUSTRALIA—NEW ZEALAND 50,000 Jobs! Big pay. Free transportation. Employer listings $2.00. Austco, Box 772-NH, Cypress, CA 90630.

AUSTRALIA . . NEW ZEALAND want you!! - Jobs!! - Paid Transportation!! - Most comprehensive directory available!! - $3 - Moneyback guarantee!! "Australia" 2208-C2 Wisconsin Ave, NW, Washington, DC 20007

MAILORDER OPPORTUNITY! Start profitable home business without experience or capital. Write for free book, plus details. No obligation. Mail Order Associates, Dept. 680, Montvale, NJ 07645

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RN, Washington, DC 20036

OVERSEAS JOBS—68 COUNTRIES! Hiring now! Paid fare. Computerized reports $2.00. Jobworld, Box 681-NH, Cypress, CA 90630

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . . Intermountain 4Y, 3506 Birch, Cheyenne, WY 82001

TEACH HERE—TEACH ABROAD: School, College openings: USA $5.95; Abroad $5.95. Placement sources: USA $4.95; Abroad $4.95. EISF, Box 662, Newton, Massachusetts 02162

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Kenya. Sampler: 4/$2.98. Free Brochure. Multinewspapers, Box DE-202, Dana Point, California 92629

Garden

HERB SEEDS

Complete Reference Guide/Seed Catalog

Discover "holistic/organic" gardening . . . Everything needed to grow and use, 200 varieties of **Insect Repellants, Medicinal Herbs, Teas, Spices, Native Wildflowers, Wildlife Habitat Seeds.** Yours for $1. ppd. (Refundable). Introductory offer: 4 large seed pkts; Camomilla, Balm, Calendula, Peppermint plus Catalog $3. Satisfaction guaranteed.

NATURALIST SEED CO. • P.O. BOX 435 – N1
YORKTOWN HEIGHTS, NY 10598

Gourmet Interests

Delicious Chile Pepper Products. Free list. Sampler with recipes, $5. Gourmet Chile Club, Box 4980 N, Albuquerque, NM 87196

FINE QUALITY GEORGIA PECANS. Perfect for pies, candies, and desserts. 5 lb. box in the shell $18 25 postpaid. 1 lb. bag whole halves shelled $8.95. Danforth Co., Rt 7, Box 78, Moultrie, GA 31768. 912-985-6576

MINNESOTA WILD RICE. $7.00 pound, five pound minimum. Floura Bros., Box 44C, Blackduck, MN 56630

Government Surplus

GOVERNMENT SURPLUS! Millions of items (Including Jeeps) . . . low as 1¢ on dollar! Most complete Directory available—$2.00. Disposal, Box 19107-RN, Washington, DC 20036

Merchandise/Gifts

"I LIKE IT WILD®. . ." Wilderness/wildlife posters, T-shirts, note cards. Send stamped envelope: Wilderness Dreams®, Box 4455-N, Shawnee Mission, KS 66204

Miscellaneous

GET CASH GRANTS—from Government. (Never repay.) Also, cash loans available. All ages eligible. Complete information, $2 (refundable). Surplus Funds-NH, 1629 K St., Washington, D.C. 20006

Music

RECORDS-TAPES! Discounts to 73%. All labels; no purchase obligations; newsletter; discount dividend certificates. 100% guarantees. Free details. Discount Music Club, 650 Main Street, P.O. Box 2000, Dept. 25-0182, New Rochelle, NY 10801

Optical

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired. Large stock Orders filled postpaid day received. Birding, Box 5N, Amsterdam, NY 12010

Personals

MEET SINGLES Mexico, Orient, Europe, Australia. Free information. Write: International, Box 1716-NH, Chula Vista, CA 92012

Real Estate

FREE! Big Spring Catalog! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Recreation, Retirement buys! Selected best throughout the U.S. Over 700 offices 43 states all across America! Yours free from the world's largest! STROUT REALTY, Inc., 60 E. 42nd St., Dept. 5390, New York, NY 10165. Call toll free: 1-800-641-4266

FREE CATALOG. Descibes and pictures farms, ranches, acreages, businesses and town and country homes from coast to coast. UNITED FARM AGENCY, INC., 612-U W. 47th St., Kansas City, MO 64112. Call Toll-Free: 1-800-821-2599; MO res. call Toll-Free: 1-800-892-5785

GOVERNMENT LANDS . . . FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00. Lands, Box 19107-RN, Washington, DC 20036

Resorts

ADIRONDACK LODGES on Upper Saranac Lake. Available for two weeks or a month, July through September. Everything provided for comfortable living in the quiet woods. $650-$1,700 for two weeks. Please write Bartlett Carry Club, RFD 3, Tupper Lake, NY 12986

ALASKAN WILDERNESS FAMILY invites you to share their coastal wilderness. Sincere, informal hospitality in a spectacular sea and mountain panorama. The place for those desiring quiet solitude; for birders, naturalists, photographers. 30 foot tides, prolific seabird and marine life. Glaciers, nesting eagles, bears, sea otters, seals, whales, untracked beaches, forest trails. Pull in crab and shrimp pots; catch salmon, trout, halibut; dig clams, gather mussels. An in-depth, educational experience. 8 guests only. $1125.00/5 days. Cozy cabins, gourmet meals. Called America's best wilderness lodge. The McBrides, China Poot Bay via Box 956NH, Homer, AK 99603, radio/phone (907) 235-8910. Write for brochure.

ALASKA. SADIE COVE WILDERNESS LODGE where the mountains meet the sea. Excellent fishing, birdwatching, photography, relaxing. Brochure. Keith Iverson, Box 2265A, Homer, Alaska 99603

BRITISH VIRGIN ISLANDS. Virgin Gorda. Deluxe seaside villa rental. Fully equipped 3 BR, 3 BTH. Spectacular view. Private beaches. Write Hartley, 125 Barn Run Ct., Huntington Station, NY 11746

NEW MEXICO. Guided tours—wildflowers, birds, prehistoric dwellings. Bear Mountain Ranch, Silver City, NM 88061 (505) 538-2538

OLD FASHIONED, Secluded Farm on Cape Breton Island offers log cabins, excellent meals, peace to a few guests. $250/week Write: John Gardner, Orangedale, Nova Scotia

SUPERB BIRDING—Resident naturalist, Musky fishing, highly rated small luxury full-service lakeside resort in National Forest, heated pool, tennis, NO speed boats or waterskiing. Ross' Teal Lake Lodge, Rt 7nh, Hayward, Wis. 54843 (715) 462-3631

TOBAGO, PRIVATE BEACH COTTAGES on working cocoa plantation. Swimming, snorkeling, fishing from your front door. Bird watcher's paradise. Brochure. Charles A. Turpin, Charlotteville, Tobago, West Indies

Tours/Trips

ADVENTURES WITH WILDLIFE—Whale Watch cruises with gray whales, humpbacks, and even blue whales. African photo safaris viewing gorillas in Rwanda, wildlife and birds in Kenya, Tanzania, Zambia, Botswana, and Madagascar. New brochure with 24 trips. ADVENTURES INTERNATIONAL Dept. NC 4421 Albert, Oakland, CA 94619

ADVENTURE TRAVEL: Tanzania Camping Safaris, Peru Natural History, Himalayan Treks, Australian Adventures. Special birdwatching and natural history departures. Overseas Adventure Travel, 1430 Mass. Ave. #303N, Cambridge, MA 02138. 617-876-0533

ALASKA NATURAL HISTORY CAMPS, North Slope and Misty Fjords. Washington wildflowers. Hawaiian Gardens Horticulture Tours. Brad's Tours, 401 E. Mercer #31D, Seattle, WA 98102

ALASKA TRAVEL ADVENTURES—Experience Alaska in guided intimate group trips. Backpacking, whitewater rafting, canoeing, kayaking, wildlife photography, fishing, custom trips. Free catalog describes 50 different trips throughout Alaska for all ages and interests. Contact Alaska Travel Adventures, 525 University Ave., Suite 610-E, Palo Alto, CA 94301. In California call collect 415-329-9013; elsewhere toll free 800-227-8480

ALASKAN WATER ADVENTURES. Kayaking, Rafting, Birding in Prince William Sound and Cooper River Basin. Open Door, Box 1185N, Cordova, Alaska 99574 (907) 424-7466

CANOE TRIPS in wilderness Nova Scotia, July-September. Small groups with licensed guides. Excellent food. Write: Granville Nickerson, RR4N, Annapolis Royal, NS B0S 1A0, Canada.

CANOE CANADA'S ARCTIC. Remote fly-in canoe expeditions in the heart of North America's last great wilderness—the tundra and taiga of Canada's Northwest Territories. Photograph caribou herds, white wolves, muskox, moose, grizzlies, rich birdlife. Spectacular fishing. Groups of 6 or 8 persons assembled and guided by Alex Hall, wildlife biologist and veteran arctic canoeing guide. All food and equipment provided Can accommodate a limited number with no previous canoeing experience. Twelve days from $1,051.00; eighteen days from $1,813.00. For brochure write: Canoe Arctic Inc., Box 130 (C), Fort Smith, NWT, Canada X0E 0P0.

COLLEGE CREDIT PACKPACKING COLORADO Mountaineering Natural History Packstocking 17-70 Yrs. 5 days $25/day. Alpenglow Educational Adventures, 139N Adams, MonteVista, CO 81144

CROSS-COUNTRY SKI from hut to hut in the high Wallowa Mountains of northeastern Oregon. Or hike and learn in the River of No Return Wilderness of Idaho. Trips for all abilities, everything provided, and small groups. Write: Wilderness Trails, P.O. Box 9252N, Moscow, Idaho 83843 (208) 882-1955

DISCOVER BAJA! Join professional naturalists & crew for ocean going exploration of Baja's wilderness islands and lagoons. Gray whales up close, elephant seals, superb birding & lots more! Excellent photo opportunities, small groups. Color brochure. Pacific Adventures Charter Service, 2445 Morena Blvd., Suite 200H, San Diego, CA 92110

DISCOVER BERMUDA—A personal journey into the natural environments of an enchanting, gentle world. June 19 & 26, 1982. Blue Sky Adventures, Natural History Vacations, Oak Ridge, NJ 07438

FREIGHTER CRUISES—First Class—Exotic—$50 daily and less. TravLtips Freighter Association, 16309-B5 Depot Road, Flushing, NY 11358

GALAPAGOS HIKING AND SAILING EXPEDITIONS. Small groups. 1982 dates: February 4, April 22, July 7, August 4. Charters. Machu Picchu options and Chili ski options. Inca Floats, 5982N Balboa, Oakland, CA 94611 (415) 339-9095

HEADWATERS OF THE AMAZON. Experience the fascinating wildlife and Indian tribes of some of the most unspoiled regions of the Amazon Basin. Expert naturalist guides. Write for free catalog: Wilderness Travel 1760-CJ Solano Ave., Berkeley, CA 94707

INDIA/NEPAL WILDLIFE SAFARI: Outstanding game observation in three major reserves + Delhi, Taj, Kathmandu, Himalayas. $1375.00. Also, comprehensive program of trekking expeditions in Nepal's Everest & Annapurna regions from $895.00. Airfares additional. Free brochure. Himalayan Travel, Inc., Box 481-NH, Greenwich, CT 06830. Toll Free (800) 243-5330

LEARNING ADVENTURES. Van safaris of the Southwest, Box 214, Boulder City, NV 89005 (702) 293-5758

MAINE ISLAND ECOLOGY. Marine biology, botany, and ornithology on 200-acre island. Exciting opportunity for high school students interested in environmental studies. Faculty/student ratio 1:5. Over 10 years of operation. From June 21 to July 9 or July 13 to July 31. Contact: Maine Island Ecology, Academy of Natural Sciences, 19th St. and the Parkway, Phila., PA 19103

OCEANOGRAPHIC EXPEDITION: Divers, naturalists needed for reef research project in New Hebrides, Solomons, PNG, Coral Sea. Share expenses, chores, sailing. Three 1982 segments begin: April, July, September. Box 1644, Brisbane, 4001, Australia.

PERU: MACHU PICCHU AND EXPLORER'S INN. Limited space available in Princeton University's Alumni College "Art & Nature in the Land of the Condor," June 1-16, 1982. Professor John Terborgh, Department of Biology, foremost authority on Peruvian birds; Gillett Griffin, Curator of Pre-Columbian Art, Princeton Art Museum. Small group. $3250 includes all expenses. Princeton University, Box 291, Princeton, NJ 08544. (609) 452-3350

SCOTTISH HIGHLANDS. Wildlife trips weekly April-October. Other wildlife destinations include Shetland, Orkney, Iceland, Tanzania, Canary Islands, Nepal, Texas, Arizona & California, and Alaska. Also backpacking and trekking in Nepal, Peru, Bhutan and Scottish Highlands. Expert leadership. Write: McGregor Travel, 33 Lewis Street, Greenwich, Connecticut 06830, or call: (800) 243-5330

SERENGETI: MIGRATION OF WILDEBEEST. 1982 departures. Send for details. Overseas Adventure Travel, 1430 Mass. Ave. #303N, Cambridge, MA 02138 (617) 876-0533

SITES & SCENES: LATIN AMERICA/AFRICA/EUROPE/CHINA. Largest program of uncommon nature and culture trips (including Trekking and Special Interest Tours) at unbeatable prices, for groups or individuals. Favorites: Peru (MachuPicchu, Amazon, Titicaca, Nazca). Ecuador (Galapagos, Devil's Railroad). Colombia ("Lost City", San Agustin). Costa Rica, (Tropical Treasure). Madagascar (Land of Living Fossils"). Kenya/Tanzania Safaris. Rwanda/Zaire (Gorilla Tracking). Greece/Turkey (textile arts, archeology). Forum Travel, 2437 Durant, Berkeley, CA 94704 415-843-8294

SMOKY MOUNTAIN FIELD SCHOOL. Intensive 5-day and 2-day field workshops in the Great Smoky Mountains National Park. Includes Wild Mammals, Birds, Natural History, and many more. Co-sponsored by Smoky Mountains National Park and University of Tennessee Continuing Education Division, 2016 Lake Ave., Knoxville, TN 379963515. (615) 974-6688

SUMMER IN YELLOWSTONE. Join us in Yellowstone National Park for field seminars on wildlife, geology, plants, art, photography, history, etc. Accommodations at Park Service facility. Academic credit available. The Yellowstone Institute, P.O. Box 515, Yellowstone National Park, WY 82190

THE BEST OF SANTA FE. May 16-21, 1982. Visit Pueblos, ancient sites and galleries in and around stimulating Santa Fe, New Mexico. Meet leading weavers, potters, jewelers. Panel discussions on Southwestern crafts and arts plus acres of tennis, hiking, riding at internationally-known Rancho Encantado. Group size limited. For full details, write Santa Fe Seminars, Suite 6, 106 S. Capitol, Santa Fe, NM 87501 or call (312) 869-6043

TREKKING IN PERU! Fabulous landscapes, magnificent nature, great people, reasonable prices: what more needs the heart? Forum Travel, 2437 Durant, Berkeley, CA 94704. 415-843-8294

TUCSON AUDUBON SOCIETY: Ecology field studies in the Sonoran Desert, April 30-May 3. Meals, lodging provided. University credit. Brochure: Desert Institute, 30-A N. Tucson Blvd, Tucson, AZ 85716

WILDERNESS CANOE TRAVEL. Alaska, Maine, and Canada. Completely outfitted trips with small groups. Northern Rivers, Box 326, Orono, ME 04473

WINTER-SUMMER SAILING SCHOOL. Learn Seamanship and Navigation. Live aboard 50′ ketch "Palisander". Caribbean, Chesapeake and Ocean passages. $600./week/person. Cuttyhunk Marine Adventures, 5 Gray, 77 Tweed Blvd., Nyack, NY 10960

RATES AND STYLE INFORMATION

$1.75 per word; 16 word ($28) minimum. *Display classified* is $150 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY to: The Market, NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024. Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—1st of the month, two months prior to cover date (the January issue closes Nov. 1). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

Additional Reading

Basel Carnival (p. 28)

In his *Feast of Fools* (Cambridge: Harvard University Press, 1969), Harvard divinity professor H.G. Cox affirms the need to once again develop the capacity for festivity and fantasy. Cox demonstrates how this capacity was well developed during the Middle Ages, when the Feast of Fools, prevalent in parts of Europe, provided people with the opportunity to lampoon rituals of state and church and to experiment with parody and role reversal. Analyzing the theological, social, and cultural history of revelry and celebration, Cox examines their loss (the Feast of Fools died out with the Reformation) and reemergence. *The Reversible World*, edited by B. Babcock (Ithaca: Cornell University Press, 1978), is a collection of literary and anthropological articles on "cultural negation" and the need to combine dichotomies, such as the ceremonial with the carnivalesque, to maintain cultural vitality. W.H. Auden's essay "Concerning the Unpredictable" (*The New Yorker*, February 21, 1970, pp. 118–25), ostensibly a review of Loren Eiseley's *The Unexpected Universe*, is more of a general essay on Eiseley and on Auden's own views of modern science, humanity, and the universe. One of the lengthier digressions in this book review focuses on the importance of laughter, the meaning of the carnival as it was known in the Middle Ages, and the necessity of festivity, work, and worship to a satisfactory human life. See also *Carnival* (Worgl: Perlinger Verlag, 1981), a collection of striking photographs by A. Orloff, some of which are reprinted in this issue, supplemented by text tracing the myth and cult of the carnival. This book is distributed in the United States by Morgan and Morgan, Dobbs Ferry, New York.

Renewable Energy (p. 41)

According to W. Clark and J. Page, authors of *Energy, Vulnerability, and War* (New York: W.W. Norton, 1981), the United States' energy system is jeopardized by its dependence on unstable supplier countries and the overcentralization of energy production, conditions that increase the nation's vulnerability to terrorism and war. Their book, based on a report commissioned by the U.S. Department of Defense, analyzes the importance of proper energy policy to national defense and provides a blueprint for coordinated energy and civil defense systems emphasizing decentralization and stability. In *Rays of Hope* (New York: W.W. Norton, 1977), author D. Hays postulates that dwindling fossil-fuel resources will force a dramatic transition in future energy technology and discusses the profound social changes such a transition will produce. He proposes that solar energy is more desirable than nuclear development, which he says is conducive to totalitarian regimes and ecological decay, and that solar energy will yield beneficial changes such as greater international equity and decentralization of energy production. *Energy Strategies*, edited by H.W. Kendall and S.J. Nadis (Cambridge: Ballinger Publishing Co., 1980), is a highly praised report by the Union of Concerned Scientists. Arguing that expanding coal, synthetic fuel, and nuclear production is expensive and risky and will compound rather than solve the energy crisis, the authors propose simple, cost effective improvements in energy efficiency and a gradual transition to soft, renewable energy sources. The study carefully analyzes the merits of different solar technologies and provides a detailed plan for an energy system that would supply all the energy required to meet estimated U.S. needs. *Soft Energy Notes* is a technical journal that prints concise reviews on the economics and potential of solar energy. Subscriptions are $25 a year for six issues, available from Friends of the Earth, 124 Spear Street, San Francisco, California 94105. *Soft Energy Paths*, by leading exponent A. Lovins (New York: Harper and Row, 1979), is an important work stating that efficient energy use, appropriate renewable sources, and individual choice can produce a sane and safe economical future. A 235-page paperback copy can be obtained from Friends of the Earth for $3.95.

Charles Knight (p. 57)

The best sources of Charles Knight's work are the books he wrote or illustrated. The following are all part of the collection of the American Museum of Natural History Library. If you cannot find these books in your local library, you may be able to request them from the Museum through an interlibrary loan program, providing the requests comply with the Museum's regulations and procedures. Among these books are: *Before the Dawn of History*, written and illustrated by Knight (New York: McGraw-Hill, 1935); *Cope: Master Naturalist*, the life and letters of Edward Drinker Cope, illustrated with drawings and restorations by Knight (Princeton: Princeton University Press, 1931); *The Dinosaur Book*, a handbook written by E.H. Colbert with illustrations by J.C. Germann and additional illustrations, previously published, by Knight and others (New York: American Museum of Natural History, 1951); *Life Through the Ages*, written and illustrated by Knight (New York: Alfred A. Knopf, 1946); *A History of Land Mammals in the Western Hemisphere*, written by W.B. Scott, illustrated by R.B. Horsfall and Knight (New York: Macmillan and Co., 1937); *Men of the Old Stone Age*, written by H.F. Osborn, illustrated by Knight, E.S. Christman, and others (New York: Charles Scribner's Sons, 1915); *The World of the Great Forest*, written by P. Du Chaillu, with more than fifty illustrations by Knight and J.M. Gleason (New York: Charles Scribner's Sons, 1900); *Aristocrats of the Air*, with a color frontispiece and fifty-three black-and-white illustrations by Knight (London: Williams and Morgate, 1925).

Dall's Sheep (p. 62)

Mountain Sheep, sheep expert V. Geist's comprehensive study of behavior and evolution (Chicago: University of Chicago Press, 1971), which won the Wildlife Society's 1972 Book of the Year award, gives information about Dall's sheep throughout. Geist studied and documented Dall's sheep behavior patterns and compared them with Stone's sheep and bighorns; see this book's section on "The Dall's Sheep Study" (pp. 31–33). Geist's well-written narrative *Mountain Sheep and Man in the Northern Wilds* (Ithaca: Cornell University Press, 1975) describes his life in a cabin in the Canadian wilderness studying sheep and other wildlife, explains his theory of the ice ages, and gives much information on the impact of cold climates on animal behavior. A. Murie's classic *Wolves of Mount McKinley (and Other Animals)* was published in 1944 as the fifth part of a series on Fauna of the National Parks of the United States. Chapter three of Murie's book is devoted entirely to Dall's sheep (pp. 62–143). It covers their history and distribution in Denali National Park and

NATURAL HISTORY MAGAZINE

NEW SUBSCRIPTIONS OR RENEWALS

SAVINGS CERTIFICATE

For *FOR THE SUM OF 9 DOLLARS*

This Subscription Savings Certificate represents a saving of $9.00 off the single-copy newsstand rate for a full year (12 issues) of NATURAL HISTORY magazine, and includes membership in the American Museum of Natural History as well.

☐ **YES!** Please send me a full year of NATURAL HISTORY for the low rate of $15 for twelve issues, and my membership card.

☐ I want to save more. Send me two years of membership and 24 issues (two years) of NATURAL HISTORY for only $26 (a $22 savings off the newsstand rate).

☐ I want to save even more. Send me three years of membership and 36 issues (three years) of NATURAL HISTORY for only $35 (a $37 savings off the newsstand rate).

☐ Payment enclosed ☐ Bill me later **Send gift to:** J536

Name ________ (please print)
Address ________
City ________
State ________ Zip ________
☐ New ☐ Renewal

Name ________ (please print)
Address ________
City ________
State ________ Zip ________
☐ 1 year $15 ☐ 2 years $26 ☐ 3 years $35

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

POSTAGE WILL BE PAID BY ADDRESSEE

NATURAL HISTORY
P.O. Box 4200
Bergenfield, N.J. 07621

Preserve, migration, food habits, disease, accidents, the rut, gestation period, lambs, relation with animals of minor importance, wolves and sheep, and wolf predation on weak sheep. L. Nichols, whose work is discussed in the present article, has done much research on Dall's sheep; see his "The Dall Sheep and Its Management in Alaska" in *Transactions of the First North American Wild Sheep Conference* (Fort Collins: Colorado State University, 1971) and his section on Dall's sheep in *Big Game of North America* (Harrisburg: Stackpole Books, 1978). I. McT. Cowan's "Distribution and Variation in the Native Sheep of North America" (*American Midland Naturalist*, vol. 24, pp. 505–80) is a general introduction to sheep, written in 1940 but still current.

Whooping Crane (p. 70)

F. McNulty's *The Whooping Crane* (New York: E.P. Dutton, 1966) won the Dutton Animal Book Award in 1966. McNulty writes about the whooping crane's rescue from extinction, Robert Porter Allen's efforts and devotion to its survival, and the establishment of the Aransas refuge. She also gives general information on crane behavior and biology. L.H. Walkinshaw's *Cranes of the World* (New York: Winchester Press, 1973) is a large-format, illustrated, comprehensive work with a useful section on the whooping crane (pp. 162–83), documenting its life history, plumage, distribution, migration, nesting, eggs, vocalizations, territory, food, and flocking behavior. R.P. Allen, who conducted a search for the whooping crane for the National Audubon Society, wrote *On the Trail of Vanishing Birds* (New York: McGraw-Hill, 1957). Half of this book is about the whooping crane; a final chapter discusses causes and possible approaches to extinction. Allen also wrote "Whooping Cranes Fight For Survival," with photographs by F.K. Truslow (*National Geographic*, November 1959, pp. 650–69), and *The Whooping Crane* (New York: National Audubon Society, 1952), a well-known monograph providing a complete life history and summary of all that was known about the whooper at the time. See also the supplement to this work, *A Report on the Whooping Crane's Northern Breeding Grounds* (New York: National Audubon Society, 1956).

Rita Campon

CHARCOAL MELLOWING
VAT NO 14
CAPACITY 2326

If you'd like to know more about charcoal mellowing, just write

IT'S IMPOSSIBLE TO PHOTOGRAPH our charcoal mellowing process. But this is a charcoal mellowing vat.

Into this vat we tamp finely ground charcoal. Then we seep our just-distilled whiskey slowly through the charcoal to mellow its taste before aging. Once the whiskey drips into the vat, there's no way to photograph what's happening. But when you compare Jack Daniel's to any other whiskey, you'll begin to get the picture.

CHARCOAL MELLOWED
DROP
BY DROP

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery,
Lem Motlow, Prop., Inc., Lynchburg (Pop. 361), Tennessee 37352
Placed in the National Register of Historic Places by the United States Government.

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: BOOKS-ON-FILE
Box 195 Dept. 72
UNION CITY, NEW JERSEY 07087

AUTHORS WANTED BY NEW YORK PUBLISHER

Leading subsidy book publisher seeks manuscripts of all types: fiction, non-fiction, poetry, scholarly and juvenile works, etc. New authors welcomed. Send for free, illustrated 40-page brochure W-82 Vantage Press, 516 W. 34 St., New York, N.Y. 10001

THE GREAT BOOK OF CATALOGS

HOW TO FIND ANYTHING BY MAIL

NEW FOR '82

Directory of over 2000 of the best mail order catalogs. Names, addresses, phones, what's in each catalog—81 product categories, 176 big indexed pages. If not satisfied return it within 30 days for immediate refund.

ORDER NOW. Send $9.95 check or Master Card/Visa no. and expiration date to:
PINKERTON MARKETING INC.
135 Oak Terrace, Box 8T, Lake Bluff, IL 60044

FREE BONUS

If you order within the next fifteen days, we will send you absolutely FREE a two month subscription to "The Best to You by Mail," a fascinating monthly newsletter. Each issue brings you details on at least 20 new catalogs, special offers, unusual new items, bargains...and much more. Send your order today!

FREE CATALOG

Premium Leather Men's Shoes and fine leather accessories at BIG FACTORY-DIRECT SAVINGS from one of America's most prestigious manufacturers

The Hanover Shoe, Inc
Dept. 9188, Box 340
Hanover PA 17331

Please mail free catalog to

(Name)

(Address)

(City) (State) (Zip)

Countryside Walks
ENGLAND - SCOTLAND
Through quaint villages and lovely scenery. Along mediaeval footpaths, prehistoric and Roman tracks . . .
17-, 18-, 9- and 10-day tours . . .
Relaxed pace . . . Small parties . . .
Country inns . . .

Please send me further information:
Name
Address

Country Walking Holidays
6195 Santa Clara Pl., Rohnert Park, CA 94928

Maryland Is for Crabs

The waters and marshy shores of Chesapeake Bay provide a bounty of seafood

by Raymond Sokolov

"Virginia," the T-shirts say, "is for lovers." I wouldn't know. But I can attest that neighboring Maryland's souvenir T-shirt boast is dead accurate. Maryland is for crabs: hard crabs, soft-shelled, crabs in soup, crab cakes, boiled crabs, and sautéed crabs. But there is much more to the seafood-based cuisine of Maryland than this one, admittedly sapid crustacean.

When I visit Baltimore, I feel, as nowhere else in this country except Louisiana, that I have penetrated a happy oxbow of old-fashioned gastronomic life, close to the land (or rather, close to the water) and far from the turbulent, queasy-making current of today's American fast-food mainstream.

It is true, of course, that Baltimore is no longer the senescent, faded port city it was when I first made a visit there ten years ago. The same firm that jazzed up Boston's Faneuil Hall district has given Baltimore's inner harbor a facelift and made a place for tourist attractions in what was once a scrofulous relic. But this squeaky-clean new center has not by any means replaced those less flamboyant restaurants and markets that survive in a direct line from Baltimore's earlier

TURTLE THAT WEIGHED
210 LBS. IT WAS CAUGHT
OFF THE NEW JERSEY COAST
8.00 doz.
80¢ each

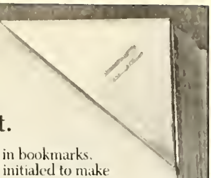
Boiled crabs are priced according to size at Baltimore's renowned Lexington Market.

days as a great trading city and the indubitable center of good eating on our Atlantic Coast. Even in the darkest days of Baltimore's recent decline, you could eat and shop magnificently in some of the same places H.L. Mencken celebrated in his sketches of the city he had known since his birth there in 1880.

To the outsider in search of its historic food emporiums, Baltimore exacts a certain amount of perseverance and does not flaunt its treasures with quite the abandon of, say, New Orleans. This is partly the result of penury and partly because until the development of the

6 doz
55¢ each

Johanna Hecht



Silver
marks
the spot.

The ultimate in bookmarks. Distinctively initialed to make it personally yours. Willoughby & Taylor's silver plated corner mark is in a class by itself. And the price is so right, it makes this unusual find the perfect hostess or thank you gift. Specify one initial for each one ordered, and please allow 6 weeks for delivery. $18 (including postage). Satisfaction guaranteed.

Willoughby & Taylor Ltd.

2912 Iron Ridge Road, Dallas, Texas 75247

Send me ______ silver plated corner bookmark(s) @ $18 each. 5R0024

Initial (for each ordered): ☐ ☐ ☐ ☐

Name ______

Address ______

City ______ State ____ Zip ______

☐ Cheque or money order enclosed.

☐ American Express ☐ VISA

☐ MasterCard Exp. date ______

Signature ______

☐ YES! Please send me a complete catalogue of international treasures, free with my order ($1.00 separately).

For charge orders, call Toll-Free (800) 527-1885. In Texas, call collect (214) 634-4500.

BE SURE YOUR NORTH COUNTRY TOUR INCLUDES

ALASKA'S GLACIER BAY

Insist on it: schedule your visit to Glacier Bay National Park. It's the highlight of any Alaska tour. Especially the way we show it to you. Alaska Exploration Holidays offers your greatest choice of experiences in this treasured preserve of active glaciers and marine wildlife: two different overnight cruises or a day cruise with accommodations at Alaska's Premiere Wilderness Resort, Glacier Bay Lodge. See Glacier Bay as a part of your Alaska Exploration Tour or as a feature of any independent itinerary. We'll tell you how! Either way, don't miss it. Send for our free full-color brochure today, or see your travel agent. Ask about Special Thrift Season Rates!

ALASKA EXPLORATION HOLIDAYS AND CRUISES

1500 Metropolitan Park Bldg. Dept. NH-GB2
Seattle, WA 98101

NAME ______

ADDRESS ______

CITY ______ STATE ______ ZIP ______

Division of Alaska Tour & Marketing Services, Inc.

Kăcȟ-ĕl-ōfen.

Kachelofen. Fashioned by skilled artisans of masonry and ceramic tile, these stately, magnificent central heaters have warmed Alpine homes for 700 years. Housed in museums and castles throughout Europe, they are viewed as national treasures.

The WESO Ceramic Tile Stove from Germany is a direct descendant of Europe's mighty kachelofens. The WESO's cast-iron firechamber is surrounded by thick, hand-glazed ceramic tile which captures and releases the fire's warmth far better than metal could.

The WESO burns wood or coal and offers every efficiency feature you could ask for. Its beauty is breathtaking. Choose from 7 decorator tile colors, and enjoy the WESO's visible fire and all-over warmth. **We have stoves for immediate delivery.**

At last. An efficient woodstove beautiful enough for your home.

Rush me your literature portfolio by first class mail, featuring the WESO in all seven tile colors, complete performance data, details on WESO's new coal stove, and current shipping schedule. Enclosed is $1 to help cover mailing costs.

Name ______

Address ______

______ Zip ______

Ceramic Radiant Heat
603/524-9663

2922 Pleasant Drive
Lochmere, N.H. 03252

Johanna Hecht

PLACE EMPTY TRAYS HERE
John W. Faidley
SEAFOOD
RAW BA
OYSTERS CLAMS

Market fare includes oysters, clams, and a variety of fishes, as well as the occasional muskrat.

inner harbor, Baltimore offered tourists no obvious focus for their wanderings. Two of the best restaurants are tucked away in neighborhoods of little obvious appeal, and the best crab house closes up for several months in the winter, when crabs are out of season.

Most tantalizing of all, Baltimore's folkloric specialty, the diamondback terrapin (*Malaclemys terrapin*), has become a rare item. Rapacious diners in Mencken's youth cut heavily into its numbers. In general, human encroachment on the terrapin's habitat—salt marsh estuaries, tidal flats, and lagoons behind barrier beaches—worked further havoc. Protective legislation has lately helped a bit, but a major Baltimore fishmonger told me recently that he didn't remember selling terrapins at all this year.

Baltimore markets are, of course, the place to discover the truth about what Baltimoreans really eat. In the several traditional markets that have survived into the modern world, one can still get a sense of the bounty that Mencken described with such mellow smugness in *Happy Days*. In his time, seafood arrived in town from the waters of Chesapeake Bay so plentifully that Mencken's mother was shocked when she actually had to pay money for shad roe. Up till then it had always been free.

Today, Chesapeake Bay shad is a costly delicacy even in Baltimore markets. One envies Mencken his easy relationship with those precious packets of myriad dark eggs, a familiarity so close that he once fell naturally into a magnificent piscatorial metaphor, extolling women who were "as fecund as the shad."

Probably the best place to recapture the spirit of Mencken's Baltimore is at the "world famous" Lexington Market, a few blocks from the city's main business center and down the block from the graveyard where Edgar Allan Poe is buried. The Lexington Market is one of those big central retail markets that every American city used to have. Stallholders rent space and compete with each other. Some of them sell prepared food. And in the profusion of eatables under the roofs of the two large single-story brick buildings of the Lexington Market, a very clever fishmonger prepares crab and oysters, sells beer, and provides simple counter space for eating these sublime shellfish in the most informal and appropriate manner.

I am not just talking about some little crab stand and a token oyster bar. I am talking about a large, extremely efficient purveyor of fruits of the sea, a place where you can choose from among eight varieties of clams and oysters, where the oysterman throws away a significant proportion of the bivalves he opens because they look dry to him, where she-crabs cost a mere $30 the bushel, and where whole crabs boiled in a peppery broth lie waiting for you in big heaps carefully graded according to size into four price categories. If you have the time and the good sense to eat your crabs in the market, the counterman will lend you a wooden mallet to crack the shell with. The crab mallet is Maryland's equivalent of Maine's lobster nutcracker. In restaurants, they also give you a small knife to cut off the ends of the claws, but a mallet and fingers and appetite are all you really need to make a splendid meal on the tear in the Lexington Market. Of course, if your appetite is larger or if you have a kitchen nearby, you can pick up any of the following within a few steps of the crab table: soft-shell crab sandwiches, regular and backfin crab cakes, crab soup, crab cake on crackers, crab cake on bread, lake trout, cod, stuffed shrimp, clam chowder, salt cod, salt herring, salt mackerel, boned shad, shad roe, finnan haddie, lobster, Boston hake, raccoon "in season," muskrat from January to March 15, cutlass fish, smelts, squid, various smoked fishes, and eel.

Ominous signs proclaim the renovation of the Lexington Market. What can be the object of such tampering? There is nothing notably shabby about the place. Wall-to-wall carpeting, or whatever is intended, can hardly improve something that is already perfect of its kind.

Paris "improved" its central market, Les Halles, and traded it in for a museum. Art will be served. But who now serves snails and beer at midnight? Where are the noctambular onion soups of yesteryear? Nowhere, and the market is removed to the suburbs—inaccessible although less forbiddingly located than the New York central market, long since opportunistically relocated in the South Bronx.

They order things better in Baltimore, so far. The Lexington Market will at least stay in the same downtown spot. And it will continue to benefit from its hinterland, the waters and marshy shores of nearby Chesapeake Bay.

That is where the crabs and the muskrats and what is left of the terrapins come from. Across the bay, along the so-called eastern shore of Maryland, crab shanties still dot the grim, flat landscape. And inside them, very hardworking people still pick crabmeat from hard blue crabs by hand.

Crab potters may legally put their pots out from May to September. Their lives at that season are controlled by the biological rhythms of the blue crab known to science as *Callinectes sapidus*. Around Chesapeake Bay, however, where almost all soft-shelled crabs are caught, the fishermen refer to these valuable arthropods with an elaborate vocabulary built around the crab's life cycle and the process by which they periodically shed their exoskeletons, or shells, thus becoming soft and entirely vulnerable to the human tooth.

A "sook" is an adult female, identifiable by bright red claw tips and the pointed, inverted V-shape of the "apron" section of the bottom of the shell. An adult male is a "jimmy"; his apron looks like an inverted T. A crab that is about to molt is a "peeler." After molting, it is called a "buster," "peeler," or "shedder." After the new shell has hardened to paper thickness, the crab becomes a "buckram" or "buckler."

Since shedding only takes about twenty-four hours from start to finish, fishermen cannot depend on catching soft-shells and then getting them to market. Instead, they have to catch them in advance and hold them in floats, watching carefully for the appearance of a red line along the edge of the "paddlers" at the rear of the crab, a premonitory sign that shedding is imminent.

Crabbing is a complicated business, exhausting and lonely. The Chesapeake Bay communities that pursue this life are isolated and self-contained. They are the underpinning that holds together the joyous gorging at Baltimore's Lexington Market and in hundreds of crab stands from Wilmington to Virginia Beach.

Raymond Sokolov's new book, Fading Feast *(Farrar Straus and Giroux), is a collection of food columns that first appeared in* Natural History.

Three recipes from *Maryland's Way: The Hammond-Harwood House Cookbook,* Annapolis.

Mrs. John Baldwin Rich's Crab Cakes

1 pound backfin crab lump (meat picked in pieces as large as possible from the main body of the crab, not the claws)
1 tablespoon flour
1 egg
¼ cup heavy cream
Salt
Black pepper
Cayenne
4 tablespoons butter

1. Put crabmeat in a bowl. Sprinkle flour over it and mix lightly to coat.
2. Beat egg, cream, and seasonings together. Pour over crab and mix gently so as not to break up the lumps of crabmeat.
3. Melt butter in a heavy skillet over medium heat.
4. Drop large spoonfuls of crab mixture into the butter and brown on both sides. The spoon you use should be large enough to contain roughly one-eighth of the full recipe.

Yield: 8 crab cakes

Carroll McTavish Elder's Muskrat Tred Avon

¼ cup vinegar
1 onion, peeled and finely chopped
1 carrot, scraped and finely chopped
1 stalk celery and leaves, finely chopped
1 clove garlic, peeled and finely chopped
2 cloves
2 tablespoons chopped parsley
1 large bay leaf, crumbled
Pepper
2 cups dry red wine
¼ cup olive oil
3 muskrats cleaned, cut up, and with musk removed
Salt
Flour
Oil or fat for frying
Currant jelly (optional)

1. Prepare a marinade by stirring together the vinegar, onion, carrot, celery, garlic, cloves, parsley, bay leaf, pepper, and red wine in a saucepan. Bring to a boil, reduce heat, and simmer for 20 minutes. Let cool.
2. Add olive oil to the marinade. Then put in the muskrat pieces and leave them to soak overnight.
3. When ready to cook and serve the final dish, drain the muskrat, season with salt and pepper, dredge in flour, and fry in hot oil or fat until brown and tender.
4. Remove cooked meat from skillet. Stir some flour into the cooking juices and cook briefly, stirring all the while. Add some strained marinade to complete the gravy. If you like, add a tablespoon of currant jelly to the gravy just before serving.

Yield: 6–8 servings

Mrs. S. Scott Beck's Terrapin in Cream

6 hard-boiled egg yolks
8 tablespoons butter
2 cups heavy cream
½ teaspoon salt
Pepper
Allspice
Nutmeg
2 cups cooked terrapin meat
½ cup sherry

1. Sieve the yolks, then cream them with the butter.
2. Scald cream over hot water, add seasonings, and beat in the egg-butter mixture.
3. Add terrapin and sherry. Heat thoroughly but do not boil.

Yield: 4 servings

The Naturemax Theater

The movie *To Fly* opens conventionally enough. On a standard-size frame we see a fellow dressed in a black suit and beaver hat, circa 1831, preparing to take off in a hot-air balloon. The balloon rises and suddenly the picture explodes to cover a screen four stories high and sixty-six feet across. We are careening over the forests of Vermont, spinning off the top of Niagara Falls, rushing through steep valleys and canyons. The audience gasps; there are a few screams and a number of vertiginous viewers hastily leave the theater.

This month, New Yorkers can experience *To Fly* when the American Museum of Natural History opens the Naturemax Theater—the first IMAX theater in the Northeast and the twelfth in the world. The IMAX system, recently developed by a group of Canadian engineers and filmmakers, uses an oversized camera to make films that are projected in specially constructed theaters. A typical screen in an IMAX theater is ten times larger than the screen in a normal theater—up to seven stories high. Because of the large screen and dynamic sound system, the IMAX film immerses the viewer in sight and sound, giving a much better illusion of reality than a normal film.

To Fly will be the first IMAX movie

Galápagos Cruise

The Museum has announced a two-week cruise from June 5 to June 17, 1982, in the Galápagos Islands. Three Museum curators—a herpetologist, an ornithologist, and a geologist—will lead sixty-five participants on a wildlife and natural history tour of this unusual archipelago, with a visit to the Andean highlands of Ecuador. The diversity and remarkable tameness of Galápagos wildlife afford excellent opportunities for study and photography. The cost of the trip is about $2,500 per person, which includes airfare. The *Galápagos Islands Cruise* is one of many Discovery Tours offered by the Museum to unusual areas of the world.

Museum and the Creative Artist

Art, like science, often takes its inspiration from nature, and the collections and exhibits at the Museum have long been a resource for artists as well as scientists. An exhibition opening in the Akeley Gallery on Wednesday, February 3, *Museum and the Creative Artist*, will feature paintings, drawings, sculpture, rubbings, and needlepoint inspired by Museum exhibits.

Black History Month

February is *Black History Month* at the Museum. The following special events are planned to highlight the cultural richness and diversity of black people worldwide. All programs are free.

People Center Events
Weekends, 1:00 to 4:00 P.M.

On Saturday, February 6, a program entitled *African Inspirations of Rhythm* will present songs and dances from Africa and the Caribbean. Dinizulu dancers and musicians will give lecture-demonstrations on the rhythms of Haiti, Ghana, and the Congo. Also on Saturday, Diana N'Diaye will give a lecture with slides on the making and use of masks.

On Sunday, February 7, *African Inspirations* will be repeated. A second program, *Masks as Art*, will explore mask making as a contemporary art form. The final program on Sunday is *Quilts of the Black World*, a lecture with slides by Carmen Lowe, comparing quilting in Africa and the New World.

On Saturday, February 13, Pam Patrick will tell Black American folk tales. Madeleine Nelson will conduct a workshop exploring the uses of the gourd as a decorated bowl, canteen, and musical instrument.

On Sunday, February 14, *Black American Folk Tales* will be repeated. Other programs will be announced.

On Saturday, February 20, a program of music, *Women of the Calabash*, will include a performance of African music using gourds as drums, kalimbas, and other instruments. *Songs, Poetry, and Tales from Africa and Black America*, a second program on Saturday, will present Kenyan songs, Black American poetry, and folk tales. Also on Saturday Jackie Strobert and Jeanie Payne will give a lecture on *George Washington Carver: The Man and His Miracles.*

On Sunday, February 21, *Unsung Heroes*, a one-man performance by Lou Myers, will dramatize the lives of several prominent black Americans. *Songs, Poetry, and Tales* and *George Washington Carver* will be repeated.

On Saturday and Sunday, February 26 and 27, three programs will be given. *Afro-Brazilian Rhythms* will be a concert of tunes from Africa, South America, and the West Indies by the Ralph Dorsey Ensemble; L.D. Frazier will explore early spirituals and gospel in a lecture-demonstration, *Origin of Gospel Music*; and Benny Kalanzi will give a lecture-demonstration of Ugandan songs, music, and stories.

Education Hall Programs
Sundays, 3:00 P.M.

On Sunday, February 14, a special program for children will feature Black American poetry and music. *Featherstone: Poetry and Song* will bring poetry to life for young people, using rhythm, music, and movement in which the children can participate.

On Sunday, February 21, *Jazz Tribute to Billie Holiday* will feature a jazz concert of Holiday's favorite pieces. The performance will include Stella Marrs on vocals, Art Blakey, Jr., on drums, Bross Townsend on piano, Charles McGhee on trumpet, and Don Hanson on saxophone. Ken Hall will moderate.

These programs are presented by the Education Department and are made possible in part by grants from the Henry Nias Foundation, the Evelyn Sharp Foundation, and a grant to Young Audiences from the American Express Foundation.

Beijing and Beyond

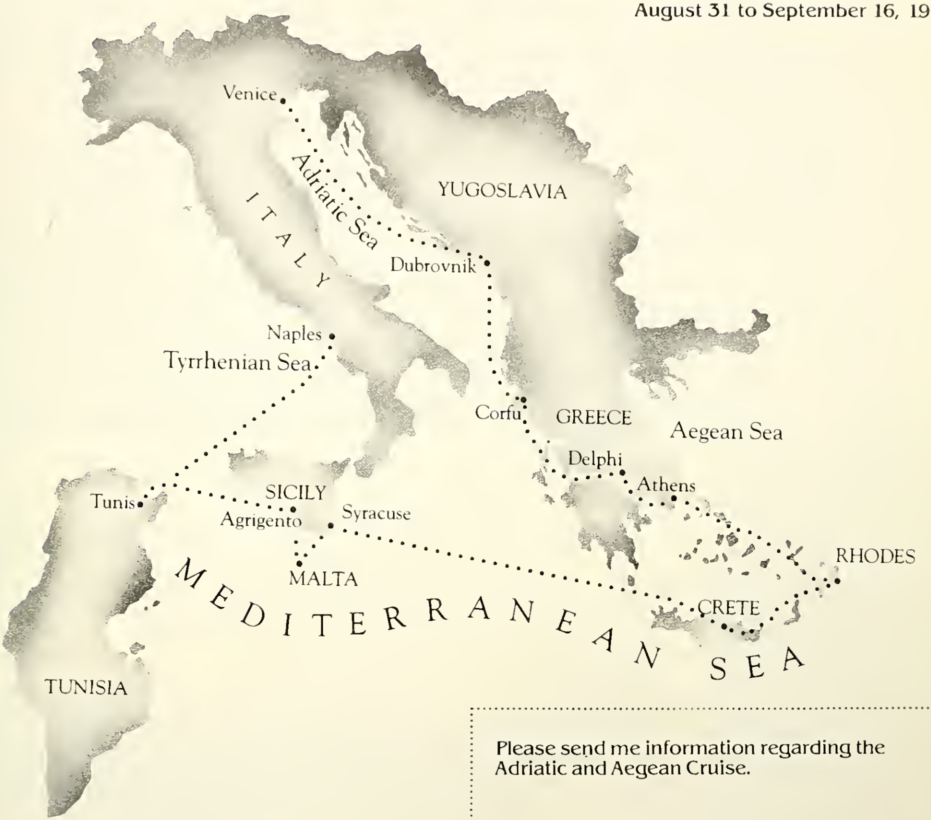
One of the highlights of last year's Margaret Mead Film Festival was the newly released film *Gui Dao—On the Way: Round Trip to Beijing*. The film, to be shown on Wednesday, February 17, at 7:30 P.M. in the Auditorium, provides a look at life on a passenger train traveling from Wuchang to Beijing. After the film, Yin Hongfu, a visiting scientist from the People's Republic of China, will answer questions about life in China today. This free program is open only to members.

For more information about programs listed in this section, call the appropriate department: Education Department (212) 873-1300; Membership Department 873-1327; Hayden Planetarium 873-1300; Discovery Tours 873-1440. Or write to the department at the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024.

THE AMERICAN MUSEUM OF NATURAL HISTORY

Adriatic, Aegean & North Africa Cruise

August 31 to September 16, 1982


Venice
Adriatic Sea
YUGOSLAVIA
ITALY
Dubrovnik
Naples
Tyrrhenian Sea
Corfu
GREECE
Aegean Sea
Delphi
Athens
Tunis
SICILY
Agrigento
Syracuse
RHODES
MALTA
CRETE
MEDITERRANEAN SEA
TUNISIA

Discover the ancient and natural wonders of Italy, Greece, Crete, Sicily, Tunis and Malta with seven distinguished lecturers and friends of the American Museum.

Dr. Thomas D. Nicholson, Director of the Museum, invites you to join him on this unique educational vacation retracing the great historical travels of the Greeks, Romans, Phoenicians and Venetians.

Our custom-designed itinerary will be executed by Swan Hellenic whose meticulous arrangements assure you of a relaxed, care-free vacation.

Discuss the fascinating ancient sites with renowned experts in Classical times . . . see and identify a host of European birds in migration with our staff ornithologist . . . explore beautiful islands, sea coasts and volcanoes with our Museum geologist . . . share evenings on deck with Dr. Nicholson learning of the ancient navigators and the stars that guided them.

Please send me information regarding the Adriatic and Aegean Cruise.

Name (Please Print)

Address

City State Zip

American Museum of Natural History

Discovery Tours

American Museum of Natural History
Central Park West at 79th Street
New York, New York
Phone: (212) 873-1440

shown in the specially reconstructed Auditorium of the Museum, and visitors can anticipate a number of disquieting special effects. To enhance the feeling of flying, the filmmakers placed the oversized IMAX camera in various unusual places. In one sequence they mounted the camera underneath an F-4 reconnaissance fighter jet flown in formation by the Blue Angels, a group of top Air Force pilots who trick-fly highly advanced jet fighters. In another, the camera was attached to the polished belly of a Boeing 747, where it filmed a takeoff; the mirrorlike underside reflected a double image of the ground rushing by and falling away. The camera was also fixed to a stunt pilot's plane; the pilot flew the craft upside down and in loops, but later couldn't bring himself to watch his aerial acrobatics on the screen. Other special mounts were developed for cars, trains, trucks, and cherry picker cranes. In another IMAX film, entitled *Circus World*, a camera was first tied to a trapeze; then, to record the sensation of falling, the camera—still running—was thrown off a high wire into a net.

But what makes all of these effects especially breathtaking is the IMAX system itself. IMAX represents an advance in filmmaking that has been compared to the invention of the stereo system in sound. It differs from conventional film in several ways. To start with, an IMAX film is projected on a screen ten times larger than the normal 35mm screen and 100 to 500 percent larger than the great 70mm Cinerama screens of Hollywood and New York. To achieve the sharpness required for such a large screen, the IMAX movie is shot by a special camera that runs 70mm film horizontally, rather than vertically, past the lens system. Each frame is more than five square inches; the 35mm frame, in contrast, is one-half square inch. Because of the size of IMAX film and the speed with which it must be run through the projector, a normal projector would tear the film apart. The inventors had to design, from scratch, a projector with an entirely new method of moving the film and a lamp bright enough to illuminate up to 7,500 square feet on screen. The result was a prototype projector the size of a Cadillac, which moves the film at 336 feet per minute, not in the usual manner, but like an inchworm, in a series of rolling loops. For a projector lamp, the inventors borrowed from NASA a 12,000-watt "solar simulator," a device NASA uses to simulate the radiation of the sun in outer space. The lamp is so hot that a two-by-four board held in front of it would burst into flame in a few seconds. Thus, to prevent a meltdown of the projector, an elaborate cooling and filtering system also had to be developed.

The IMAX theater itself employs a six-channel speaker system that surrounds the audience with high-fidelity sound, adding to the illusion of reality. The system lends itself particularly well to spectacular films about nature. Some IMAX films are *North of Lake Superior*, filmed in 1971, which has close shots of a raging forest fire, and *Volcano*, a short film that takes the viewer into the caldron of an erupting volcano on Iceland. *Man Belongs to the Earth*, an IMAX film starring Chief Dan George, allows viewers to experience the stillness of the Northwest Coast's rain forests, then takes them on a terrifying raft ride down the Colorado River. Filmmakers took an IMAX camera into the depths of the ocean to film the frolics of the elusive humpback whale in *Nomads of the Deep*.

Since July, renovations in the Museum's Auditorium have prepared the way for the IMAX system in the Museum's new Naturemax Theater. Engineers designed an immense screen, forty feet high and sixty-six feet wide, the first retractable IMAX screen in the world. When the Naturemax Theater is not in use, the screen rolls up under the stage floor, freeing the Auditorium for concerts, dance performances, and regular films.

The Naturemax Theater in the Museum will open to the public on Thursday, February 11. A member can obtain one free ticket for the Naturemax Theater with the voucher bound into this issue. Regular admission is $2.00 for adults and $1.00 for children. Double features of *To Fly* and *Living Planet*, shown every Friday evening, cost $5.50. For more information about the Naturemax Theater, call the Museum at (212) 496-0900.

Douglas J. Preston

A hot-air balloon soars over the Vermont landscape in the IMAX film To Fly.

A new benefit for Members
of the American Museum of Natural History

Your Free Coupon for...

TO FLY

An unbelievable film experience

Strap yourself into the Museum's new *Naturemax Theater* with its enormous screen four stories high and sixty-six feet wide. Soar through the Grand Canyon, glide across Niagara Falls, float off the volcanic cliffs of Hawaii, rip through the sky on the belly of an F-4 jet fighter. *To Fly* is an irresistible film fantasy that opens at the Museum February 11, 1982 for an extended run.

Your coupon may be redeemed for one free ticket at the Naturemax Ticket Desk in the 77th Street Lobby. Additional tickets may also be purchased there. A valid membership card must be presented with your coupon.

For daily schedules and more information, please call: (212) 496-0900.

DETACH HERE

MEMBERS' COMPLIMENTARY COUPON

EXPIRES: DECEMBER 31, 1982

GOOD FOR

ONE FREE TICKET

TO FLY

In the Naturemax Theater

Museum Members with a valid membership card may exchange this coupon for one free ticket at the Naturemax Ticket Desk in the 77th Street Lobby. For daily schedules and more information, please call: (212) 496-0900

NON-TRANSFERABLE

AMERICAN MUSEUM OF NATURAL HISTORY

A new benefit for Members of the
American Museum of Natural History

TO FLY

an unbelievable film experience
in the Museum's new
Naturemax Theater

Opening February 11, 1982
for an extended run.

*Save the Complimentary Members' Coupon below
for your free Naturemax Ticket.*

MEMBERS' COMPLIMENTARY COUPON

To Fly, an irresistible film fantasy, will open in the American Museum of Natural History's new *Naturemax Theater* on February 11, 1982 for an extended run. Naturemax is the Museum's extraordinary, new large-format film projection system. The screen is so huge that you become a part of the action itself. For daily schedules and more information, please call: (212) 496-0900.

AMERICAN MUSEUM OF NATURAL HISTORY
Central Park West at 79th Street New York, New York

"It's life as usual in the big wildlife reserve nearby," says Orval Fouse, Supervisor, Utilities & Environmental Engineering at Gulf's Port Arthur, Texas, refinery. "The snow geese still spend a few months here each year during migration. The marshes around the refinery are still full of raccoons, otters, minks, muskrats, even some deer and bobcats.

"To me, that's very good news, because it means they're totally unaffected by the fact that, for the past 20 years, we've been refining what's called 'sour crude.'

"We call it sour because it contains a lot of pollutants. We have to take some sour crude when we buy oil overseas. Of course, we can't release those pollutants into the air. So Gulf spent millions of dollars modernizing this refinery to handle this type of crude. For 20 years now, we've been refining over 100,000 barrels of sour crude a day, and as you can see by the wildlife around here, the air quality is as good as ever."

We have prepared a brochure, "In Search of Balance," on the ways and means of balancing energy and nature. You may have a copy, free, by writing to Mr. William E. Moffett, Vice President, Public Affairs, Gulf Oil Corporation, Department SG, Box 1166, Pittsburgh, Pennsylvania 15230.

Gulf

Gulf people: energy for tomorrow.

© Gulf Oil Corporation 1981

"Can oil and wildlife mix? They do at Gulf's Port Arthur refinery."

Snow Goose (C. Caerulescens), photographed near Gulf's Port Arthur refinery by Dr. John Tveten.

hexa·photo·cybernetic
The Possibilities are Endless.

Six-mode exposure control.
System versatility. Newer electronics
for wider applications.

SHUTTER PRIORITY AE
ELECTRONIC FLASH AE
MANUAL
STOPPED-DOWN AE
APERTURE PRIORITY AE

The Canon A-1 is one of the world's most advanced automatic SLR cameras. Combining the finest in optical and mechanical engineering with the most sophisticated electronics, it's technology applied to give you the ultimate in creative control. At the touch of a button.

Depending on your subject, you can choose from six independent exposure modes to achieve the results you want:

1 Shutter-Priority: You select the shutter speed, to freeze the action and prevent camera shake or create an intentional blur. The A-1 automatically selects the appropriate lens opening.

2 Aperture-Priority: Control the area in focus by selecting the lens opening for the effect you want. The A-1 matches with the right speed.

3 Programmed: When you need to shoot fast, just focus. The A-1 will select *both speed and aperture* for great results.

4 Stopped-Down: For extreme close-up or specialized photography, a bellows, a microscope or almost anything can be attached to the A-1. It's still automatic.

5 Flash: Totally automatic flash photography, of course, with a wide variety of Canon Speedlites to choose from.

6 Manual: Yes. For those times when you absolutely want to do it all yourself. To experiment. To explore the possibilities.

Canon
A-1
LENS MADE IN JAPAN
CANON
CANON LENS FD 50mm 1:1.8

Programmed: 350 9.5

Canon
Canon

There are over forty fine Canon lenses ranging from Fish Eye to Super Telephoto, plus accessories to meet every need. If you can't photograph your subject with a Canon A-1, it probably can't be photographed.

From the sophistication of its LED viewfinder display, to a ruggedness that allows up to five-frame-per-second motor drive, the Canon A-1 represents an incredible technology. At a price that makes owning one a definite possibility.

Canon A-1

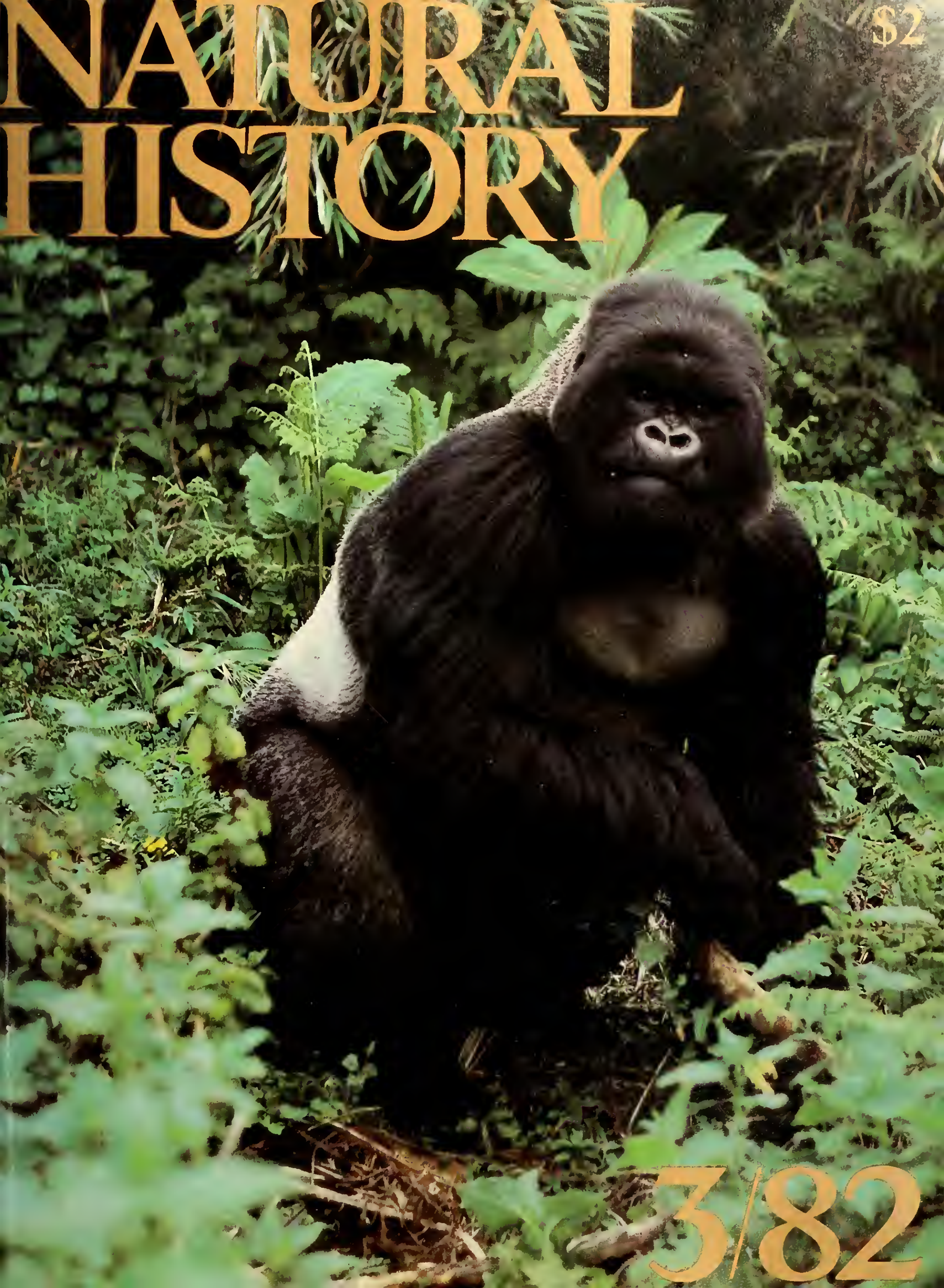
Canon USA, Inc., One Canon Plaza, Lake Success, New York 11042 • 140 Industrial Drive, Elmhurst, Illinois 60126 • 6380 Peachtree Industrial Blvd., Norcross, Georgia 30071 • 123 Paularino Avenue East, Costa Mesa, California 92626 • Bldg. B-2, 1050 Ala Moana Blvd., Honolulu, Hawaii 96814 • Canon Canada, Inc., Ontario

© 1981 Canon U.S.A., Inc.

NATURAL HISTORY

$2

3/82



12 YEARS OLD WORLDWIDE • BLENDED SCOTCH WHISKY •
86 PROOF • GENERAL WINE & SPIRITS CO., N.Y., N.Y.

CHIVAS REGAL
FOUNDED 1801
BLENDED SCOTCH WHISKY
12
It's enough to make you want to get lost.

The 1982 Natural History
Magazine Photographic
Competition
. . . See page 28

NATURAL HISTORY

Vol. 91, No. 3, March 1982

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director

Alan Ternes, Editor
Judith Friedman, Managing Editor
Thomas Page, Designer
Board of Editors: Carol Breslin,
Sally Lindsay, Frederick Hartmann,
Vittorio Maestro, Rebecca B. Finnell
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
E. Kay Danzig, Art Asst.
Kay Zakariasen, Picture Editor
Douglas J. Preston, Publications Editor
Annie R.C. Finch, Editorial Asst.
Lillian Berger
Editorial Advisers:
Malcolm Arth, James W. Atz,
Niles Eldredge, Kenneth L. Franklin,
E.Craig Morris, Norman Newell,
Thomas D. Nicholson, Martin Prinz,
Gerard Piel, Nina Root

David D. Ryus, Publisher
Bradford D. Smith, Business Manager
Frederick E. Grossman, Production Mgr.
Debra Buck McCord, Asst. Production Mgr.
Ernestine Weindorf, Administrative Asst.
Elaine M. Callender, Advtg. Production Mgr.

Cary Castle, Circulation Manager
Jeff Pieper, Assoc. Circulation Mgr.
Ramôn E. Alvarez, Asst. Circulation Mgr.
Frank Stevens, Circulation Asst.

NATURAL HISTORY *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024.*
Subscriptions: $15.00 a year. In Canada and all other countries: $18.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.

Copyright © 1982 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.*

Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225
Subscription Orders (800) 247-5470
(800) 532-1272 (in Iowa)

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

2 Authors

4 This View of Life *Stephen Jay Gould*
Moon, Mann, and Otto

12 Sky Reporter *Donald J. Kessler*
Junk in Space

22 Bios *Paulette Bierzychudek*
Jack and Jill in the Pulpit

30 The Nature of Lichens *Vernon Ahmadjian*
Do the fungi and algae have a mutualistic or parasitic relationship?

38 The Lost and Lonely Birds of Mauritius *Roger Pasquier and Carl Jones*
Conservationists must think increasingly in terms of triage.

44 From Child to Fisherman *Enid Schildkrout, photographs by Jeffrey Jay Foxx*
Ghanaian children playfully learn the work of "well-organized and willing men."

48 Gorilla Society *Text and photographs by Peter G. Veit*
Inbreeding must be avoided in an endangered, isolated species.

60 In the Volcano *Haraldur Sigurdsson*
The floor, and your knees, shake more often inside an intermittently active volcano.

72 Books in Review *Joseph Kastner*
Curious Wonders

78 At the American Museum
Champions of American Sport

82 Celestial Events *Thomas D. Nicholson*

84 Additional Reading

86 A Matter of Taste *Raymond Sokolov*
Heavy Date

Cover: *Icarus, a silverback about seventeen years old, may be slowly taking over the leadership of a group of mountain gorillas in the Virunga volcanoes conservation region of Rwanda. Photograph by Peter G. Veit. Story on page 48.*

Authors

Vernon Ahmadjian is professor of botany and chairman of the Biology Department at Clark University in Worcester, Massachusetts. As an undergraduate at Clark, Ahmadjian learned that the lichens in Worcester County had never been studied. "The idea that we were studying something that no one had looked at before was exciting," he says, "and it started my lifelong preoccupation with lichens." Today, his research is focused on the biology and development of lichens, including their structure, chemistry, and genetics. Ahmadjian has pursued the cosmopolitan lichen throughout the continental United States and to places as disparate as Antarctica, Hawaii, and Sweden.

A research associate in the Division of Birds of the U.S. National Museum, **Roger Pasquier** also serves as executive assistant to the president of the International Council for Bird Preservation. In the latter capacity, he assumed responsibility for the ICBP Mauritius project, which is vitally concerned with the endangered birds on that Indian Ocean island. Pasquier is the author of the popular book *Watching Birds: An Introduction to Ornithology*, and is working on a volume on the birds of Panama. He maintains that his favorite birding spot remains New York City's Central Park.

Peter G. Veit had completed a study of female reproductive cycles in elephant seals when the opportunity arose to do field research on the same subject in mountain gorillas. The work was conducted at the Karisoke Research Centre in the Parc des Volcans, Rwanda. Veit, who was born in Erlangen, West Germany, is now analyzing and writing up his data, and pursuing a Ph.D. in ecology at the University of California, Davis. His next research project will be on the primates of Kalimantan, Indonesia.

Coauthor **Carl Jones** is a wildlife biologist assigned to the ICBP Mauritius project. His research has focused on the ecology and behavior of the endangered birds of Mauritius, and the development of management techniques for the conservation of the island's fauna. Prior to working on Mauritius, he studied the comparative aspects of the growth and development of raptors in Wales, where he was associated with Swansea University. A native of Wales, Jones professes a passionate love of birds of prey, and the perilous state of the Mauritian kestrel has been of particular concern to him.

Volcano Hot Spot

A specialist in volcanology with an advanced degree in geology, **Haraldur Sigurdsson** has investigated approximately fifteen volcanoes scattered around the world. His favorite among them, which he has visited about fifty times, is the one in the Caribbean he writes about in this issue. Born in Iceland but a resident of the United States for the past seven years, Sigurdsson admits to being hooked on volcanoes. They satisfy what he refers to as his "incessant curiosity about how the earth works as a living organism." Since 1974, he has taught at the Graduate School of Oceanography at the University of Rhode Island. Sigurdsson's most recent article for *Natural History* was "An Active Submarine Volcano," October, 1979.

The rare 19th Century Viennese Lantern Style Regulator Clock.

The classic Viennese Lantern Clocks were originally created by the "Grossuhrmachers" of the Black Forest during the 19th Century to individual order.

Now, private collectors only are invited to acquire this exceptional replica, superbly crafted by the Hamilton Clock Company. Solid brass precision movement, with Westminster chimes.

The cabinet is mitered and coped fine wood construction, in your choice of solid mahogany or solid walnut. Dimensions are: 45 inches high, 12 inches wide and 8 inches deep. Priced at $750.00. This edition will be strictly limited to 1,500.

MAIL THIS COUPON OR CALL 1-800-233-0281 EXT. 175* TO SUBSCRIBE OR FOR FURTHER DETAILS.

***In Pennsylvania call 717-394-7161/Ext. 175**

Please send me more information about the Viennese Lantern Style Regulator Clock. I understand that only 1,500 of these clocks will be made in a Limited Edition.

Name________________

Address________________

City________________

State________ Zip________

The Collector's Classic Edition Society, Ltd.

(A wholly owned subsidiary of Hamilton Watch Co. Inc. Dept. 273. 941 Wheatland Ave.
Lancaster, PA 17604)

Moon, Mann, and Otto

"God bless the dedicated teachers of this world"

by Stephen Jay Gould

Little Rock, Arkansas
December 10, 1981

This morning's *Arkansas Gazette* features a cartoon with searchlights focused on a state map. The map displays neither topography nor political boundaries, but merely contains the words, etched in black from Oklahoma to the Mississippi: "Scopes Trial II. Notoriety." I spent most of yesterday—with varying degrees of pleasure, righteousness, discomfort, and disbelief—in the witness box, trying to convince Federal Judge William R. Overton that all the geological strata on earth did not form as the result of a single Noachian deluge. We are engaged in the first legal test upon the new wave of creationist bills that mandate equal time or "balanced treatment" for evolution and a thinly disguised version of the Book of Genesis read literally, but masquerading under the nonsense phrase "creation science." The judge, to say the least, seems receptive to my message and as bemused as I am by the fact that such a trial can be held just a few months before the hundredth anniversary of Darwin's death.

The trial of John Scopes in 1925 has cast such a long shadow into our own times that the proceedings in Little Rock inevitably invite comparison. I appreciate the historical continuity but am more impressed by the differences. I sit in a massive alabaster building, a combined courthouse and post office, a no-nonsense, no-frills edifice, surrounded by the traffic noises of downtown Little Rock. The Rhea County Courthouse of Dayton, Tennessee—the building that hosted Scopes, Darrow, and Bryan in 1925—is a gracious, shaded, and decorated Renaissance revival structure that dominates the crossroads of its two-street town (see my column of November, 1981). The Scopes trial was directly initiated by Dayton's boosters to put their little town on the map; many, probably most, citizens of Arkansas are embarrassed (however amused) by the anachronism on their doorstep. John Scopes was convicted for even mentioning that humans had descended from "a lower order of animals"; we have made some progress in half a century, and modern creationists clamor for the official recognition of their pseudoscience, not (at least yet) for the exclusion of our well-documented conclusions.

Yet the ghost of Scopes affects me as I sit here contemplating the differences—and I recall a small incident of six months ago, and a column I meant to write that got lost somewhere in the Galápagos.

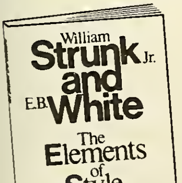
I decided to be a paleontologist when I was five, after an awe-struck encounter with *Tyrannosaurus* at the Museum that sponsors this magazine. The phenomenology of big beasts might have been enough to sustain my interest, but I confirmed my career six years later when I read, far too early and with dim understanding, G.G. Simpson's *Meaning of Evolution* and discovered that a body of exciting ideas made sense of all those bodies of bone. Three years later, I therefore approached my first high school science course with keen anticipation. In a year of biology, I would surely learn all about evolution. Imagine my disappointment when the teacher granted Mr. Darwin and his entire legacy only an apologetic two days at the very end of a trying year. I always wondered why, but was too shy to ask. Then I just forgot my question and continued to study on my own.

Six months ago, in a secondhand bookstore, I found a copy of my old high school text, *Modern Biology*, by T. J. Moon, P. B. Mann, and J. H. Otto. We all appreciate how powerful an unexpected sight or odor can be in triggering a distant "remembrance of things past." I knew what I had the minute I saw that familiar red binding with its embossed microscope in silver and its frontispiece in garish color, showing a busy beaver at work. The book, previously the property of a certain "Lefty," was soon mine for 95 cents.

Now, more than half a life later (I studied high school biology in 1956), I finally understood why Mrs. Blenderman had neglected the subject that so passionately interested me. I had been a victim of Scopes's ghost (or rather, of his adversary, Bryan). Most people view the Scopes trial as a victory for evolution, if only because Paul Muni and Spencer Tracy served Clarence Darrow so well in theatrical and film versions of *Inherit the Wind*, and because the trial triggered an outpouring of popular literature by aggrieved and outraged evolutionists. Scopes's conviction (later reversed on a technicality) had been a mere formality; the battle for evolution had been won in the court of public opinion. Would it were so. As several historians have shown, the Scopes trial was a rousing defeat. It abetted a growing fundamentalist movement and led directly to the dilution or elimination of evolution from all popular high school texts in the United States (see J. V. Grabiner and P. D. Miller, "Effects of the Scopes Trial," *Science*, vol. 185, 1974, pp. 832–37; and D. Nelkin, *Science Textbook Controversies and the Politics of Equal Time*, M.I.T. Press, 1977). No arm of the industry is as cowardly and conservative as the publishers of public school texts—markets of millions are not easily ignored. The situation did not change until 1957, a year too late for me, when the Russian Sputnik provoked a searching inquiry into the shameful state of science education in America's high schools.

Moon, Mann, and Otto commanded the lion's share of the market in the mid-1950s; readers of my generation will probably experience that always exhila-

SPECIAL BONUS WHEN YOU JOIN



Whether you write letters, term papers or novels, you can make "every word tell" with the aid of this famous guide to the principles of plain English. You'll learn how to cut deadwood out of your sentences, put statements in a positive form, develop a simple, orderly, sincere style. "An indispensable tool without which life would be miserable"
—Chicago *Sun-Times.*

BOOK-OF-THE-MONTH CLUB®
America's Bookstore® since 1926

Facts About Membership

As a member you will receive the *Book-of-the-Month Club News*® 15 times a year (about every 3½ weeks). Every issue reviews a Main Selection and 150 other books that we call Alternates, which are carefully chosen by our editors. If you want the Main Selection, do nothing. It will be shipped to you automatically. If you want one or more Alternates—or no book at all—indicate your decision on the Reply Form and return it by the specified date. *Return Privilege:* If the *News* is delayed and you receive the Main Selection without having had 10 days to notify us, you may return it for credit at our expense. *Cancellations:* Membership may be discontinued, by either you or the Club, at any time after you have purchased 4 additional books. Join today. With savings and choices like these, no wonder Book-of-the-Month Club is America's Bookstore.®

Book-of-the-Month Club, Inc., Camp Hill, Pennsylvania 17011

Please enroll me as a member of Book-of-the-Month Club and send me the set I have checked below, billing me for the appropriate amount, plus shipping and handling charges. Also send my special bonus book, *The Elements of Style.*

I agree to buy 4 books during the next two years. A shipping and handling charge is added to each shipment.

Check one box only:

☐ 935. Remembrance Things Past **$10**
☐ 943. Great Ladies of Song (11 Records) **$12.50**
☐ 912. Compact OED **$19.95**
☐ 941 Washington Set **$9.95**
☐ 944 Great Ladies of Song (6 Cassettes) **$12.50**
☐ 913. The Story of Civ **$24.95**
☐ 942 Random House Library of Painting & Sculpture **$15**
☐ 946 Great Ladies of Song (6 8 Track Tapes) **$12.50**

A113-3-3

Mr
Mrs.____________________ **2-55**
Miss
(Please print plainly)

Address____________________ Apt______

City____________________

State____________________ Zip______

Prices shown are U.S. prices. Outside the U.S., prices are generally higher.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

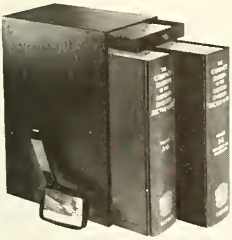
BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 224 CAMP HILL, PA.

POSTAGE WILL BE PAID BY ADDRESSEE

Book-of-the-Month Club, Inc.
Camp Hill, Pennsylvania 17011

Choose one of these five sets and save up to 282^{50}

You simply agree to buy 4 books within the next two years.



The Compact Edition of The Oxford English Dictionary

The "most complete, most scholarly dictionary of the English language"—*The Christian Science Monitor.* Through photo-reduction, the original 13-volume set has been reproduced in this two-volume Compact Edition. Magnifying glass included.

$125.00	Publisher's price
-$105.05	Your savings
$ 19.95	Book-of-the-Month Club price

THE American Language
H. L. MENCKEN
Fourth Edition

The American Language by H. L. Mencken

Mencken's masterpiece and the standard work on the subject: a robust and witty three-volume study of English as it has evolved in the United States by borrowing words, phrases and slang from a rich variety of sources.

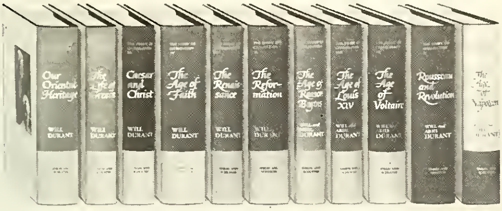
$75.00	Publisher's prices total
-$65.00	Your savings
$10.00	Book-of-the-Month Club price

JEFFERSON THE VIRGINIAN
JEFFERSON AND THE RIGHTS OF MAN
JEFFERSON AND THE ORDEAL OF LIBERTY
JEFFERSON THE PRESIDENT
JEFFERSON THE PRESIDENT
JEFFERSON AND HIS TIME
THE SAGE OF MONTICELLO

Jefferson and His Time by Dumas Malone

The landmark six-volume set that is "a masterly achievement of scholarship, the finest biography of Jefferson we have or are likely to have and a monumental triumph of the senior American historian"—*The New York Times Book Review.*

$109.90	Publisher's prices total
-$ 94.90	Your savings
$ 15.00	Book-of-the-Month Club price


Our Oriental Heritage
The Life of Greece
Caesar and Christ
The Age of Faith
The Renaissance
The Reformation
The Age of Reason Begins
The Age of Louis XIV
The Age of Voltaire
Rousseau and Revolution
The Age of Napoleon
WILL DURANT

The Story of Civilization by Will and Ariel Durant

For almost half a century Will and Ariel Durant traced the continuity of world history—the religions and philosophies, the political and economic tides, the arts and sciences, the customs and conquests—to show the foundations of society today. The Durants' 11-volume illustrated masterwork is history come alive in all its dimensions. The enormous scope of the work covers ancient and recent civilization, including Oriental as well as Western history. A Book-of-the-Month Club exclusive for close to 50 years, it is both a reference work of undisputed authority and a lively portrait of the rulers and leaders who have shaped the course of history. A magnificent centerpiece for any home library.

$307.45	Publisher's prices total
-$282.50	Your savings
$ 24.95	Book-of-the-Month Club price

BEETHOVEN NINE SYMPHONIES
THE CHICAGO SYMPHONY
SIR GEORG SOLTI
BEETHOVEN
The Five Piano Concertos
Vladimir Ashkenazy
Sir Georg Solti conducting
The Chicago Symphony Orchestra

The Nine Beethoven Symphonies & The Five Piano Concertos/Ashkenazy

A special offering of two of the most acclaimed recordings in years. Sir Georg Solti conducts The Chicago Symphony in the nine-record set of Beethoven's complete symphonies, hailed by *Time* as "a glorious musical combustion." In collaboration with Vladimir Ashkenazy, Solti and the Chicago Symphony perform Beethoven's five concertos. *High Fidelity* calls it "a major addition to the Beethoven discography." Available in 13 records or 8 cassettes.

$115.74	List prices total
-$ 99.79	Your savings
$ 15.95	Book-of-the-Month Club price

Book-of-the-Month Club, Inc., Camp Hill, Pennsylvania 17012 **A116-3-1**

Please enroll me as a member of Book-of-the-Month Club and send me the work I have checked below, billing me for the appropriate amount, plus shipping and handling charges. I agree to buy 4 books during the next two years. A shipping and handling charge is added to each shipment.

CHECK ONE BOX ONLY

☐ 912. Compact OED $19.95
☐ 913. The Story of Civ. $24.95
☐ 915. American Language $10
☐ 932. Beethoven (13 Records) $15.95
☐ 933. Beethoven (8 Cassettes) $15.95
☐ 934. Jefferson & His Time $15

Mr.
Mrs.________________________________2-61
Miss (Please print plainly)

Address____________________________Apt.______

City_______________________________________

State______________________________Zip______

Prices shown are U.S. prices. Outside the U.S., prices are generally higher.

BOOK-OF-THE-MONTH CLUB®
America's Bookstore® since 1926

Benefits of Membership. Membership in the Book-of-the-Month Club begins with your choice of the extraordinary works offered here. Because our prices are generally lower than the publishers', you will save on works such as these throughout your membership as well as on the finest new fiction and nonfiction titles. In fact, the longer you remain a member, the greater your savings can be. Our Book-Dividend® plan, for which you become eligible after a brief trial enrollment, offers at least 70% off the publisher's price on art books, reference works, classics, books on cooking and crafts, literary sets and other contemporary works of enduring value. Nevertheless, all Book-of-the-Month Club books are equal in quality to the publishers' originals; they are not condensed versions or cheaply made reprints.

As a member you will receive the *Book-of-the-Month Club News*® 15 times a year (about every 3½ weeks). Every issue reviews a Main Selection and 150 other books that we call Alternates, which are carefully chosen by our editors. If you want the Main Selection, do nothing. It will be shipped to you automatically. If you want one or more Alternates—or no book at all—indicate your decision on the Reply Form and return it by the specified date. *Return Privilege:* If the *News* is delayed and you receive the Main Selection without having had 10 days to notify us, you may return it for credit at our expense. *Cancellations:* Membership may be discontinued, either by you or the Club, at any time after you have purchased 4 additional books. Join today. With savings and choices like these, no wonder Book-of-the-Month Club is America's Bookstore.

rating sense of *déjà vu* with me. Like many popular books, it was the altered descendant of several earlier editions. The first, *Biology for Beginners*, by Truman J. Moon, was published in 1921, before the Scopes trial. Its frontispiece substituted Mr. Darwin for the industrious beaver, and its text reflected a thorough immersion in evolution as the focal subject of the life sciences. Its preface proclaimed: "The course emphasizes the fact that biology is a unit science, based on the fundamental idea of evolution rather than a forced combination of portions of botany, zoology and hygiene." Its text contains several chapters on evolution and continually emphasizes Darwin's central contention that the *fact* of evolution is established beyond reasonable doubt, although scientists have much to learn about the *mechanism* of evolutionary change. Chapter 35, on "The Method of Evolution," begins: "Proof of the *fact* of similarity between the various forms of living things and of their very evident relationship, still leaves a more difficult question to be answered. *How* did this descent and modification take place, by what means has nature developed one form from another? [Moon's italics]"

I then examined my new purchase with a growing sense of amusement mixed with disgust. The index contained such important entries as "fly specks, disease germs in," but nothing about evolution. Indeed, the word evolution does not occur anywhere in the book. The subject is not, however, entirely absent. It receives a scant 18 pages in a 662-page book, as chapter 58 of 60 (pp. 618–36). In this bowdlerized jiffy, it is called "The hypothesis of racial development." Moon, Mann, and Otto had gone the post-Scopes way of all profitable texts: eliminate and risk no offense. (Those who recall the reality of high school courses will also remember that many teachers never got to those last few chapters at all.)

This one pussyfooting chapter is as disgraceful in content as in brevity. Its opening two paragraphs are a giveaway and an intellectual sham compared with Moon's forthright words of 1921. The first paragraph provides a fine statement of historical continuity and change in the *physical* features of our planet:

> This is a changing world. It changes from day to day, year to year, and from age to age. Rivers deepen their gorges as they carry more land to the sea. Mountains rise, only to be leveled gradually by winds and rain. Continents rise and sink into the sea. Such are the gradual changes of the physical earth as days add into years and years combine to become ages.

Now what could be more natural and logical than to extend this same mode of reasoning and style of language to life? Indeed, the paragraph seems to be set up for such a transition. But note how the language of the second paragraph subtly shifts to avoid any commitment to historical continuity for organic change:

> During these ages, species of plants and animals have appeared, have flourished for a time, and then have perished as new species took their places. . . . When one race lost in the struggle for survival, another race appeared to take its place.

Only four pages later do we get an inkling that genealogy may be behind organic transitions through time: "This geological story of the rocks, showing fossil gradations from simple to complex organisms, is what we should expect to find if there had been racial development throughout the past." Later on the page, Moon, Mann, and Otto ask the dreaded question and even venture the closest word they dare to "evolution": "Are these prehistoric creatures the ancestors of modern animals?" If you read carefully through all the qualifications, they answer their question with a "yes"—but you have to read awfully hard.

Thus were millions of children deprived of their chance to study one of the most exciting and influential ideas in science, the central theme of all biology. A few hundred, myself included, possessed the internal motivation to transcend this mockery of education, but citing us seems as foolish and cruel as the old racist argument, "what about George Washington Carver or Willie Mays," once used to refute the claim that poor achievement might be linked to economic disadvantage and social prejudice.

Now I can mouth all the grandiloquent arguments against such a dilution of education: we will train a generation unable to think for themselves, we will weaken the economic and social fabric of the nation if we raise a generation illiterate in science, and so on. I even believe all these arguments. But this is not what troubled me most as I read chapter 58 in Moon, Mann, and Otto. I wasn't even much angered, but merely amused, by the tortured pussyfooting and glaring omissions. Small items with big implications are my bread and butter, as any consistent reader of this column knows only too well; I do not react strongly to generalities. I can pass by a displeasing general tenor, but I cannot bear falsification and debasement of something small and noble. I was not shaken emotionally until I read the last paragraph of chapter 58, but then an interior voice rose up and began to compose this column many months ago. For to make a valid point in the context of their cowardice, Moon, Mann, and Otto had perverted (perhaps unknowingly) one of my favorite quotations. If cowardice can inspire such debasement, then it must be rooted out.

The last paragraph is titled: Science and Religion. I agree entirely with its first two sentences: "There is nothing in science which is opposed to a belief in God and religion. Those who think so are mistaken in their science or their theology or both." They then quote (with some minor errors, here corrected) a famous statement of T. H. Huxley, using it to argue that a man may be both a Darwinian and a devout Christian:

> Science seems to me to teach in the highest and strongest manner the great truth which is embodied in the Christian conception of entire surrender to the will of God. Sit down before fact as a little child, be prepared to give up every preconceived notion, follow humbly wherever and to whatever abysses nature leads, or you shall learn nothing. I have only begun to learn content and peace of mind since I have resolved at all risks to do this.

Now a man may be both an evolutionist and a devout Christian. Millions successfully juxtapose these two independent viewpoints, but Thomas Henry Huxley did not. In fact, this quote out of context actually speaks of Huxley's courageous agnosticism and occurs in what I regard as the most beautiful and moving letter ever written by a scientist.

The tragic context of this long letter explains why Huxley cited, only in analogy as Moon, Mann, and Otto did not understand, "the Christian conception of entire surrender to the will of God." Huxley's young and favorite son had just died. His friend, the Reverend Charles Kingsley (best remembered today as author of *The Water-Babies* and *Westward Ho!*) had written a long and kind letter of condolence with a good Anglican bottom line: see here Huxley, if you could only abandon your blasted agnosticism and accept the Christian concept of an immortal soul, you would be comforted.

Huxley responded in tones that recall the chief of police in Gilbert and Sullivan's *Pirates of Penzance* who, when praised by General Stanley's daughters

NO LEADING IMPORT IS HIGHER THAN SUBARU IN OWNER LOYALTY.

Subaru owners have a lot in common. Including the habit of trading in one Subaru for another Subaru.*

If that isn't the best endorsement any car can earn, we don't know what is.

One good reason people stick with Subaru is for its day in, day out reliability. The last time Road and Track surveyed Subaru owners, they reported "... one of the most trouble-free cars we ever surveyed."**

Another reason is the wide choice of models. There's the sporty 2-door hardtop. The luxurious 4-door sedan. The versatile hatchback. And the roomy station wagon.

Every Subaru has full-time front wheel drive. In addition, three of our models — Hatchback, Station Wagon, Brat — are also available with On *Demand* Four Wheel Drive. Which is four wheel drive at the flick of a lever. Without stopping.

(Any other 4 wheeler around requires a full stop before switching. And stopping is exactly what you can't do sometimes.)

Some attractive options we offer are the Hill-Holder™ (a device on our manual transmission models† that keeps you from drifting back after stopping on steep hills), as well as power windows and power steering, AM/FM stereo, cassette deck, cruise control. All the wonderful unnecessities of driving.

32 EPA EST. MPG!!

Plus one huge necessity: outstanding gas mileage. Our cars are designed to squeeze every last mile out of every last drop. Year after year.

45 EPA EST. HWY.!!

Just remember that it's quite easy to find an inexpensive car. The trick is to find one that stays that way.

SUBARU®

INEXPENSIVE. AND BUILT TO STAY THAT WAY.

BEGINNING OF TRAIN STOP
TICKETS
U.S. MAIL RAILWAY POST OFFICE
TICKET & FREIGHT OFFICE

* THE R.L. POLK AND COMPANY 1980 SURVEY OF LATE MODEL OWNERS.

** ROAD & TRACK — NOVEMBER 1979 ISSUE

† AVAILABLE ON CERTAIN MODELS.

†† 1982 EPA ESTIMATES FOR OUR FWD 5-SPEED HATCHBACK. USE EST. MPG FOR COMPARISONS. YOUR MILEAGE MAY DIFFER DEPENDING ON DRIVING SPEED, WEATHER CONDITIONS AND TRIP LENGTH. ACTUAL HWY MILEAGE WILL PROBABLY BE LESS.

© SUBARU OF AMERICA, INC. 1981

for expected bravery in a coming battle that will probably lead to his bloody death, remarks:

> Still, perhaps it would be wise
> Not to carp or criticise,
> For it's very evident
> These attentions are well meant.

Huxley thanks Kingsley for his sincerely proffered comfort, but then explains in several pages of passionate text why he cannot alter a set of principles established after so much thought and deliberation merely to assuage his current grief.

He has, he maintains, committed himself to science as the only sure guide to truth about matters of fact. Since matters of God and soul do not lie in this realm, he cannot know the answers to specific claims and must remain agnostic. "I neither deny nor affirm the immortality of man," he writes. "I see no reason for believing in it, but, on the other hand, I have no means of disproving it." Thus, he continues, I cannot assert the certainty of immortality to placate my loss. Uncomfortable convictions, if well founded, are the ones that require the most assiduous affirmation, as he states in the lines just before the passage quoted by Moon, Mann, and Otto: "My business is to teach my aspirations to conform themselves to fact, not to try and make facts harmonize with my aspirations."

Later, in the most moving passage of the letter, he speaks of the larger comfort that a commitment to science has provided him—a comfort more profound and lasting than the grief that his uncertainty about immortality now inspires. Among three agencies that shaped his deepest beliefs, he notes, "Science and her methods gave me a resting-place independent of authority and tradition." (For his two other agencies, Huxley cites "love" that "opened up to me a view of the sanctity of human nature," and his recognition that "a deep sense of religion was compatible with the entire absence of theology.") He then writes:

> If at this moment I am not a worn-out, debauched, useless carcass of a man, if it has been or will be my fate to advance the cause of science, if I feel that I have a shadow of a claim on the love of those about me, if in the supreme moment when I looked down into my boy's grave my sorrow was full of submission and without bitterness, it is because these agencies have worked upon me, and not because I have ever cared whether my poor personality shall remain distinct forever from the All from whence it came and whither it goes.

High yields?
Yes.
Easy access?
Yes.
Free checks?
Yes.
And no penalties!

Start with just $2,500. You can add to your account at any time with investments as low as $100. And you're not locked into any time period. Your money is always available whenever you need it, with no penalty for withdrawal. For full details on this popular money market fund, mail coupon or call today.

Dreyfus Liquid Assets

For more complete information, including management fee charges and expenses, obtain a prospectus by sending this coupon. Read it carefully before you invest or send money.

Post Office Box 600
Middlesex, NJ 08846

FOR A PROSPECTUS

Call toll free, day or night, 7 days a week
1-800-345-8501
Extension 850
In Pennsylvania
1-800-662-5180
Extension 850

Name__________
Address__________
City__________
State__________ Zip__________
0493 2260112

Of course, in a bank your principal is insured and does not fluctuate, but your investment has a fixed return.

The start of a fine home library

Let us send you, for the token price of only $1 each, three books that have served as cornerstones in many a fine home library.

The complete works of Shakespeare

This beautiful 1300-page volume contains every word Shakespeare ever wrote. All 37 of his comedies, tragedies, and historical dramas including Hamlet, Romeo and Juliet, Macbeth, etc. Also all of his poems and sonnets.

The works of Kipling

Actually eight books in one. A complete novel and 139 stories, ballads and verses loved the world over, including Mandalay, Gunga Din, The Phantom Rickshaw, etc.

The works of De Maupassant

128 matchless tales by the acknowledged master of the short story. Every story complete and unexpurgated: The Diamond Necklace, A Piece of String, The Will, etc.

Each volume is clothed in a handsomely-tooled binding of antique ecru with both the elegant look and feel of leather.

You will enjoy reading these books, just as millions before you have. Your friends will admire them, perhaps even envy you for owning them. And your children will gain a real advantage with books like these always close at hand.

We offer you three books of this calibre for only $1 each to introduce you to our new Golden Giants Series. We think you will be impressed. And we hope you will want to own others in the Series, as they become available, including:

Hugo. 36 complete works including Hunchback of Notre Dame, A Woman of the Streets, The Souls.

Stevenson. 39 novels, stories, poems. Treasure Island, Dr. Jekyll and Mr. Hyde, Kidnaped, etc.

Doyle. All the best of Sherlock Holmes—The Sign of The Four, Red-Headed League, plus other works.

Poe. 91 works: Annabel Lee, The Raven, The Gold Bug, Murders in the Rue Morgue, etc.

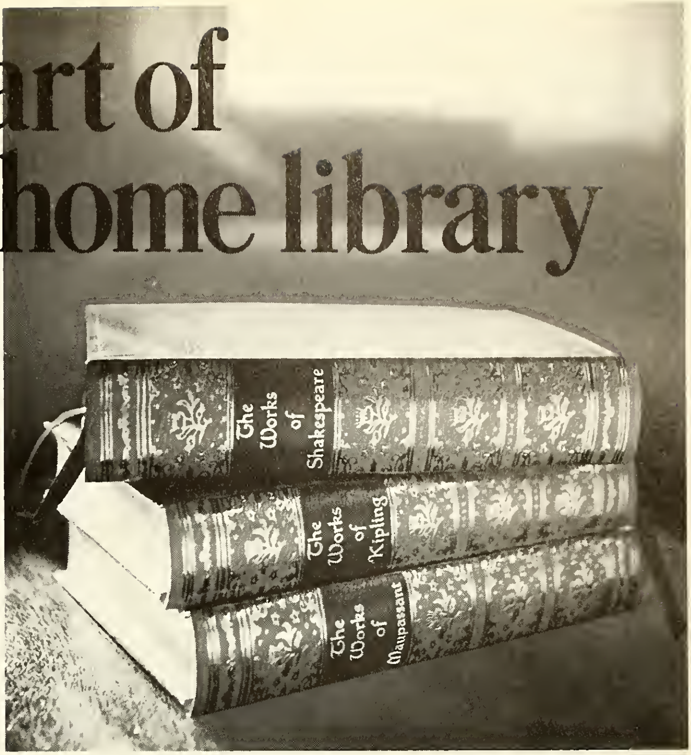
The full series will also include the works of Cellini, Wilde, Ibsen, Browning, Longfellow, Emerson, Dostoevsky, Byron and many others.

Normally, you would expect to pay $12 each or more for deluxe editions of books like these. But our direct-to-the-public method of book distribution (which we have specialized in for over 50 years) lets us make these volumes available for only $9.89 each, plus shipping.

Send no money now. Simply mail coupon to get your first three volumes for only $1 each, plus shipping, and to reserve the privilege of examining future volumes as they come from the press.

You will receive advance description of all upcoming volumes. You may reject any book before or after you receive it. And you may cancel your reservation any time you wish.

Mail coupon to: Black's Readers Service, Roslyn, New York 11576.



Regularly $29.67. Now only $1 each.

Black's Readers Service

ROSLYN, NEW YORK 11576

Please enroll me as a subscriber and send me at once SHAKESPEARE, KIPLING and DE MAUPASSANT. I enclose *no money now*. After a week's examination, I will either keep my books and pay $3 (plus shipping) or return them.

Also reserve for me additional volumes in the Golden Giants of Literature Series. As a subscriber, I will get advance descriptions of future volumes. For each volume I choose, I will pay just $9.89 (plus shipping). I may return any book, for full credit within 21 days and I may cancel my reservation at any time.

MR./MRS./MS. ______________________ 2-XQ
(Please print plainly)

ADDRESS ______________________

CITY & STATE ______________________ ZIP ____________

Note: Subscribers accepted in U.S.A. and Canada only; offer slightly different in Canada G02D6N

L.L.Bean®

FREE Spring Catalog

Fully illustrated. Features quality apparel and footwear for men, women and children; fishing, hiking, camping and canoeing gear. For 70 years L. L. Bean has offered practical and functional merchandise at reasonable prices. Our clothing and footwear is rugged enough to withstand active outdoor use, yet attractively styled and comfortable for casual wear. Many items are of our own manufacture. All fully guaranteed.

☐ SEND FREE CATALOG

Name__________

Address__________

City__________

State______Zip______

L. L. Bean, Inc.
711 Casco St., Freeport, ME 04033

NATURALIST ADVENTURE TOURS 1982
"custom designed for the discerning explorer"

Costa Rica Birds & Botany
June / Dr. Daniel Guthrie**
Highlights include Las Cruces, Tortugero and Monteverde. See Quetzals, Bellbirds, Sea Turtles and Sloths in their natural habitat.

Peru's Natural History
July-August / Dr. Daniel Guthrie**
Tour features the Amazon River, Cuzco, the Incan ruins at Machu Picchu and the Ballestas Islands.

Arizona Birding
August / Dr. Henry E. Childs***
Trogons, 5-Striped Sparrows and Becards are native to the areas visited which include Cave Creek, Madera Canyon and Patagonia.

Fall Foliage & Garden Tour
October / Dr. Bruce McAlpin*
4 states host this exciting visit to some of the world's most prestigious gardens, meticulously manicured with decades of loving attention.

For more information contact:
Naturalist Adventure Tours Dept.
c/o Far West Travel Corp., Inc.
3000 Ocean Park Blvd., Suite 1008
Santa Monica, CA 90405
or call: **(213) 450-3040**

Tour Leaders:
*Dr. Bruce McAlpin, Asst. Horticulturalist of the New York Botanical Garden. Well known for his creation of the famous Fern Gallery.
**Dr. Daniel Guthrie, Biology Dept. Claremont Colleges and President, Pomona Valley Audubon.
***Dr. Henry E. Childs, Ornithologist & Professor at Chaffee College

And thus, my dear Kingsley, you will understand what my position is. I may be quite wrong, and in that case I know I shall have to pay the penalty for being wrong. But I can only say with Luther, "Gott helfe mir, ich kann nichts anders [God help me, I can do no other]."

Thus we understand what Huxley meant when he spoke of "the Christian conception of entire surrender to the will of God" in the passage cited by Moon, Mann, and Otto. It is obviously not, as they imply, his profession of Christian faith, but a burning analogy: as the Christian has made his commitment, so have I made mine to science. I can do no other, despite the immediate comfort that conventional Christianity would supply in my current distress.

Today I sat in the court of Little Rock, listening to the testimony of four splendid men and women who teach science in primary and secondary schools of Arkansas. Their testimony contained moments of humor, as when one teacher described an exercise he uses in the second grade. He stretches a string across the classroom to represent the age of the earth. He then asks students to stand in various positions marking such events as the origin of life, the extinction of dinosaurs, and the evolution of humans. What would you do, asked the assistant attorney general in cross examination, to provide balanced treatment for the 10,000-year-old earth advocated by creation scientists. "I guess I'd have to get a short string," replied the teacher. The thought of twenty earnest second graders, all scrunched up along one millimeter of string, created a visual image that set the court rocking with laughter.

But the teachers' testimony also contained moments of inspiration. As I listened to their reasons for opposing "creation science," I thought of T. H. Huxley and the courage required by dedicated people who will not, to paraphrase Lillian Hellman, tailor their convictions to fit current fashions. As Huxley would not simplify and debase in order to find immediate comfort, these teachers told the court that mechanical compliance with the "balanced treatment" act, although easy enough to do, would destroy their integrity as teachers and their responsibility to students.

One witness pointed to a passage in his chemistry text that attributed great age to fossil fuels. Since the Arkansas act specifically includes "a relatively recent age of the earth" among the definition of creation science requiring "balanced treatment," this passage would have to be changed. The witness claimed that he could not do it. Why not? retorted the assistant attorney general in his cross examination. You only need to insert a simple sentence: "Some scientists, however, believe that fossil fuels are relatively young." Then, in the most impressive statement of the entire trial, the teacher responded. I could, he argued, insert such a sentence in mechanical compliance with the act. But I cannot, as a conscientious teacher, do so. For "balanced treatment" must mean "equal dignity" and I would therefore have to justify the insertion. And this I cannot do, for I have heard no valid arguments that would support such a position.

Another teacher spoke of similar dilemmas in providing balanced treatment in a conscientious rather than a mechanical way. What then, he was asked, would he do if the law were upheld. He looked up and said, in his calm and dignified voice: It would be my tendency not to comply. I am not a revolutionary or a martyr, but I have responsibilities to my students, and I cannot forego them.

God bless the dedicated teachers of this world. We who work in unthreatened private colleges and universities often do not adequately appreciate the plight of our colleagues—or their courage in upholding what should be our common goals. What Moon, Mann, and Otto did to Huxley epitomizes the greatest danger of imposed antirationalism in classrooms—that one must simplify by distortion, and remove both depth and beauty, in order to comply.

In appreciation for the teachers of Arkansas, then, and for all of us, one more statement in conclusion from Huxley's letter to Kingsley:

> Had I lived a couple of centuries earlier I could have fancied a devil scoffing at me . . . and asking me what profit it was to have stripped myself of the hopes and consolations of the mass of mankind? To which my only reply was and is—Oh devil! truth is better than much profit. I have searched over the grounds of my belief, and if wife and child and name and fame were all to be lost to me one after the other as the penalty, still I will not lie.

Postscript: On January 5, 1982, Federal District Judge William R. Overton declared the Arkansas act unconstitutional because it forces biology teachers to purvey religion in science classrooms.

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

Why we
take care of our
trees.

If you were a farmer whose only crop had a 50 year growing cycle, you'd take very good care of it, right? Well, we are that farmer. Our crop takes 50 years, on average, to reach maturity.

That's why we plant up to six seedlings for every tree we harvest, why we nurture them, prune them, thin them, protect them from insects, disease and fire.

That's why we continually explore new forest management techniques that promise more trees per acre, and new manufacturing processes that promise more wood and paper per tree.

That's why we increasingly use what once was wasted, either to make products like yeast, chunk bark and particleboard, or to generate energy.

It's a matter of self-interest, finally. Only by managing our trees prudently can we provide the jobs, products and profits we all need and the forests we all love.

Boise Cascade Corporation
Wood and paper for today, trees for tomorrow.

Junk in Space

Man-made debris circling the earth in relatively low orbits threatens the safety of future space missions

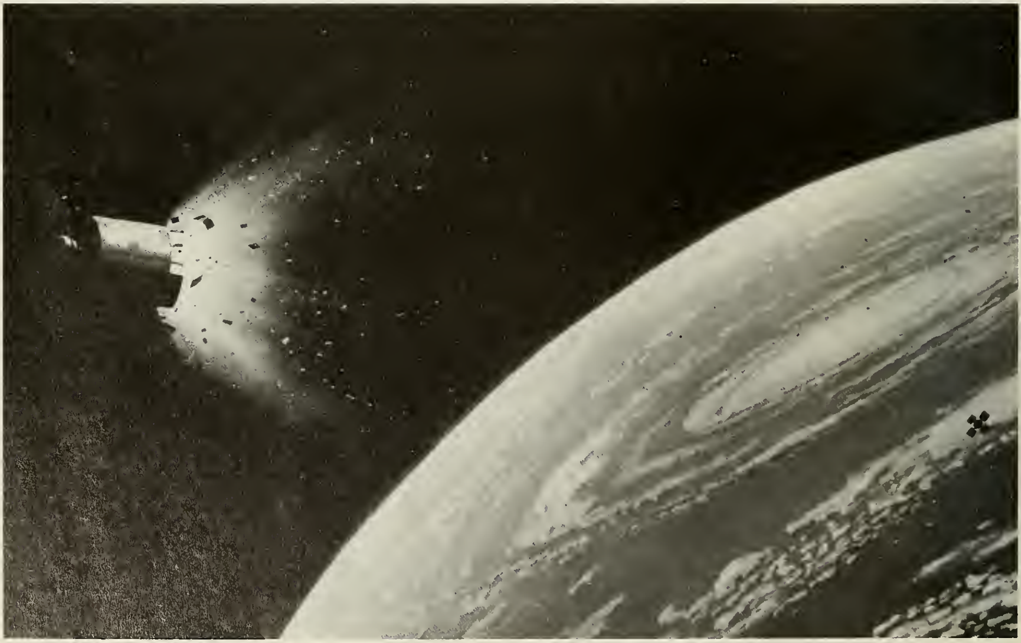
by Donald J. Kessler

The space age is only twenty-five years old but Earth's orbital space has already been turned into something of a junkyard. About 5,000 man-made objects are currently being tracked in Earth orbit. Only a small fraction of these are functioning satellites that carry such instruments as radiation detectors, atmospheric monitors, communication relays, cameras, and mass spectrometers. Most are either no longer functioning satellites, burned-out rocket stages, or fragments from the breakup of rockets and satellites. No one knows how many additional man-made objects, too small or too high up to be detected, may also be circling the earth.

Public attention has largely been focused on the presumed risk that these objects may fall to Earth, causing deaths and physical damage. For example, when the nuclear-powered Soviet surveillance satellite Cosmos 954 reentered the earth's atmosphere over Canada in 1978, following a sudden depressurization, many feared that it might have spread radiation over that country. None was found, however. Similarly, there was much consternation in the summer of 1979 when, despite NASA's effort to cause the unmanned Skylab to fall into either the Indian or Atlantic ocean, the spacecraft reentered the earth's atmosphere over Australia. Even though it created a brilliant display in the Australian night sky, nothing on the earth was damaged as Skylab broke up in the atmosphere and pieces of it fell on the continent. Were we lucky? Not exactly. For purposes of comparison, the risk to humans on the ground is far greater from automobiles, airplane crashes, lightning, and other occurrences.

Every year, between 500 and 1,000 man-made objects reenter the earth's atmosphere from greater altitudes, but most of them are so small that they burn up before hitting the ground. In any given year, more than 10,000 meteoroids of comparable size, or larger, also enter the earth's atmosphere from outer space, but only about 500 of these become meteorites, surviving to hit the ground. Thus, the risk to people on the ground is greater from meteorites than

High-energy satellite explosions, such as that depicted in this painting, are one source of dangerous, small, man-made objects in Earth's orbital space.



William K. Hartmann

Old Bushmills.
It's changing people's minds about Irish Whiskey.

IMPORTED
FROM THE WORLD'S OLDEST DISTILLERY
OLD BUSHMILLS
IRISH WHISKEY
TRADE MARK
ORIGINAL GRANT
1608

A blend of 100% Irish Whiskies. 80 proof. Bottled in Ireland. The Jos. Garneau Co., New York, N.Y. ©1980

For free food and drink recipes, write to Old Bushmills, P.O. Box 639, New York, New York 10018. To send Old Bushmills anywhere in the country, call toll free: (800) 528-6148. Void where prohibited.

Experience the taste
that experience created.
Old Bushmills.
Since 1608.

PICK UP A BARGAIN IN EUROPE.

AS LITTLE AS $112 A WEEK.

With the Hertz Affordable Europe program you'll get a great weekly rate on a fuel-efficient subcompact with unlimited free mileage.

Rent a car in Germany for example, for as little as $112. Or in Spain for as little as $119.* And get all the extras you expect from #1:

- Over 600 locations throughout Europe.
- No pre-payment. Hertz is the only major rental car company that doesn't require payment when you book.
- Rates guaranteed in local European currency.
- Hertz emergency service network on call all over Europe.

For further details and other European rates see your travel consultant, or call Hertz at 1-800-654-3001.

Hertz also has low weekly rates on larger cars. Cars must be reserved at least 14 days in advance. These rates are non-discountable and do not include gas or optional charges. *Rates are guaranteed in local European currency from April 1, 1982-March 31, 1983 (Germany $112/252 marks, Spain $119/11,550 pesetas). Dollar equivalents may fluctuate with changing exchange rates.

Hertz
AFFORDABLE EUROPE
HERTZ RENTS FORDS AND OTHER FINE CARS.

® REG. U.S. PAT. OFF. © HERTZ SYSTEM INC. 1982

from space debris; yet no one in recorded history has ever been killed by a meteorite fall. Where then is the danger from high-flying trash? The hazard exists, not on the ground, but in space, specifically in Earth's orbital space.

Although the fact may not yet be widely recognized, satellites in space have become a subtle but pervasive part of our everyday life. They play an important role in such activities as military and nonmilitary surveillance, astronomical observations, communications, and weather prediction, and they serve as navigation aids. But space—the new frontier—offers even more than cheap and efficient ways of carrying out familiar tasks. With no gravity, space can also make possible the manufacture of such products as crystals that are larger than those produced on Earth and chemical compounds that are purer. Consequently, there is increasing competition to get into space rapidly and inexpensively. In the future, NASA believes, the most cost-effective way of putting objects into space will be reusable launch vehicles, combined with manned space stations equipped for the building and servicing of satellites. Developments such as these might someday make the colonization and industrialization of space economically attractive, perhaps sparing the earth the strains of continual growth and development. On the other hand, there are a variety of high-altitude environmental hazards that, unless dealt with, could well preclude certain activities in space or at least dissipate their presumed economic advantages. In order to deal with these hazards, it is necessary to correct several misconceptions concerning Earth's orbital space and the objects in it.

The first concerns the extent of the usable space in Earth orbit. Unlike outer space, this region is definitely finite, reaching upward from about 100 to about 22,000 miles. The North American Air Defense Command (NORAD) is charged with the responsibility of tracking man-made objects in Earth orbit. Since NORAD's purpose is to identify objects that may represent a threat to national security, it is most interested in the largest objects, but objects as small as four inches in diameter are also tracked. NORAD currently monitors the orbits of the approximately 5,000 objects in Earth orbit. At any one time, more than half of these are found between the altitudes of 300 and 700 miles. At this altitude, a large space station—say, 300 feet in diameter—would have about one chance in twenty of being hit by one of these man-made objects over a period of ten years. This compares with less than one chance in 20,000 of being hit by a meteoroid of the same size. Thus, for certain space vehicles, man-made debris already represents a much greater risk than objects in the natural environment.

The second, and perhaps more important, misconception is that objects in space float relative to one another, and hence any collision damage results from relatively large objects bumping—rather than smashing—into each other or into smaller objects. This view has frequently been promoted by Hollywood. In the movies, when a spacecraft passes through a meteor shower or a stream of asteroids, the dangers are shown to be large rocks drifting by the spacecraft at relatively low speeds. Similarly, spacecraft are shown as drifting slowly past each other. The fact is that low velocities can only be achieved when objects are intentionally placed in nearly identical orbits and this rarely occurs unless it has been preplanned. The average speed at which meteoroids collide with spacecraft, for example, is twelve miles per second. The average speed at which two typical spacecraft pass each other is six miles per second. At those speeds, an object only one-half inch in diameter has as much collision energy as a hand grenade. Objects as small as one twenty-fifth of an inch in diameter will penetrate the structures of most spacecraft, spraying the inside with ejected matter. Hence, even a grain-sized meteoroid or piece of space debris can destroy important spacecraft electronics or cause the loss of pressure in a pressurized structure. During the 1960s NASA conducted research to determine the probability of a collision between a spacecraft and a small meteoroid. The risk was considered high enough to cause shielding to be added to many spacecraft, including both Skylab and Apollo, and to spacesuits, in order to insure an acceptable level of protection.

This level of protection would be sufficient if natural objects posed the only threat to spacecraft. But there is also the possibility that a large number of man-made objects with diameters of less than one-half inch might be in Earth orbit. In fact, this is not only possible but probable. The primary source of these small objects is the same as the source of small meteoroids, namely, the breakup of larger objects.

If a large number of man-made objects are currently in Earth orbit, they could have been produced by any of the

Is there a place in the American Dream for children like Patricia Bright Flower?

Save the Children's Indian Nations Program invites you to befriend a needy child and help build a better tomorrow...for all Americans.

Americans have always taken pride in our land of equal opportunity. Our belief that hard work brings rewards. And our hope that all children will grow to fulfill their potential.

American Indian children like Patricia Bright Flower would like to share this dream. On reservations where lack of jobs and education threaten the economic survival of the family, children like Patricia dream of things we take for granted. More nutritious meals. Warmth against the winter's cold. Needed school supplies and the encouragement to attend school.

With the country's largest private nonsectarian program serving American Indians, Save the Children has for 50 years been helping hardworking people like the Eastern Band of Cherokee help themselves. As a Save the Children sponsor you can bring hope for a better future to children like Patricia Bright Flower for just 52¢ a day.

When you become a sponsor, your funds will be used to help children in the most effective way possible—by helping the entire community with projects and services. For health care, education, food production and nutrition, and other projects and services that build community self-sufficiency.

And for you, there's more. You'll get to know the child you sponsor through a photograph, personal history, and reports. Even an exchange of letters, if you wish.

Fifty-two cents a day may not buy much where you live. But for the poorest of the poor, where the need is so desperate, it can work miracles.

Photo: Joe Loya

Please fill out this coupon today and help save the children.

1. ☐ **Yes, I want to become a Save the Children sponsor.**
My first monthly sponsorship payment of $16 is enclosed.

2. **What kind of child would you like to sponsor?**
☐ Boy ☐ Girl ☐ Either

3. **Where would you like to help?**
☐ **Where the need is greatest**
☐ In the United States ☐ Overseas

American Indian Nations Program
☐ Apache
☐ Arizona tribes
☐ Navajo
☐ Plains tribes
☐ Eastern Cherokee/Choctaw
☐ Sierra Nevada tribes
☐ Hopi/Pueblo

Other U.S. programs
☐ Appalachia
☐ Chicano
☐ Inner Cities
☐ Southern States

4. ☐ **Instead of becoming a sponsor at this time, I am enclosing a contribution of $________.**
☐ Please send me more information.

Name____________________
(Please print)

Address____________________

City__________ State_____ Zip________

The original U.S. child sponsorship agency. We are indeed proud of our use of funds. Our annual report and financial statement are available upon request. YOUR SPONSORSHIP PAYMENTS AND CONTRIBUTIONS ARE U.S. INCOME TAX DEDUCTIBLE.

Save the Children®

HELPING CHILDREN 50 years 1932 • 1982

50 Wilton Road, Westport, Connecticut 06880
Att: David L. Guyer, President

© 1981 SAVE THE CHILDREN FEDERATION, INC.

NH 3/2

"Delightfully readable and illuminating."
—*Ashley Montagu*

THE SEX CONTRACT
The Evolution of Human Behavior
HELEN E. FISHER

What draws man and woman together as mates? Why do we love, lie, cry, make war, and share? These and other questions concerning the evolution of our common behavior patterns are answered in an exciting new book certain to fuel the present controversy over human origins. "Well-written, lively... an enjoyable combination of scientific expertise and imagination which reads like a first-rate detective novel."
—Stanley A. Freed, *The American Museum of Natural History*

$13.50
Selected by the Book-of-the-Month Club

William Morrow
105 Madison Avenue, New York N Y 10016

The 1982 Program

Stimulate your mind on a Questers nature tour. We search out the plants and animals, birds and flowers... and explore rain forests, mountains and tundra, seashores, lakes and swamps. There is ample time to photograph, absorb, reflect. Naturalist guides, small tour parties, first-class accommodations.

Worldwide Nature Tours
1982 Departures

The Americas
Everglades: 11 days, Apr. 8, Nov. 4 • Hawaii: 15 days, Feb. 14, Mar. 21, Oct. 10, Dec. 19 • Alaska: 17 days, June 12, 26, July 10, 24, Aug. 7 • Pacific Northwest: 12 days, June 20, Aug. 1 • Superior Forest Canoe Trip: 9 days, July 10, Aug. 14 • Northwest Canada: 16 days, July 2 • Churchill: 11 days, July 17 • Newfoundland: 16 days, June 13 • Baja California: 11 days, Apr. 16, Oct. 15 • Southern Mexico: 14 days, Feb. 14, Dec. 19 • Costa Rica & Panama: 16 days, Feb. 13, Nov. 20, Dec. 18 • The Amazon: 17 days, Jan. 17, May 9, July 4, Aug. 8, Oct. 10, Nov. 14 • Galapagos: 15 days, Jan 28, Apr. 22, July 15, Aug 5, Oct. 28 • Peru: 23 days, July 17, Nov. 6 • Patagonia: 21 days, Nov. 6 • Trinidad & Tobago: 11 days, Mar. 8, Nov. 8.

Europe
Iceland: 16 days, June 11, July 2, Aug. 6 • Islands/Highlands of Scotland: 21 days, May 27, July 15, Aug. 19 • Switzerland: 17 days, July 16, Aug 13 • Greece: 19 days, Mar. 29, Sept. 20 • Spain: 20 days, Apr. 16, Sept. 3

Asia and Africa
Israel: 16 days, Mar. 15, Oct. 18 • The Himalayas: 23 days, Mar. 18, Oct. 7 • India: 23 days, Jan. 30, Oct. 30, Nov. 27 • Sri Lanka: 18 days, Feb. 19, Nov. 19 • Kenya: 23 days, Feb. 4, July 22, Oct. 21 • Zimbabwe & Botswana: 19 days, July 8, Aug 5.

Australasia
Australia & New Zealand: 30 days, Feb. 13, Oct. 2 • New Zealand & the Milford Track: 22 days, Feb. 12, Nov. 12 • The Complete Australia: 35 days, Sept. 3.

To learn more, write requesting the 1982 Directory of Worldwide Nature Tours. Indicate if you are interested in any particular tour and we will send the corresponding Detailed Itinerary.

QUESTERS
Questers Tours & Travel, Inc.
Dept. NH, 257 Park Avenue South
New York, NY 10010 • (212) 673-3120

sixty explosions—some accidental, some planned—that are known to have occurred in space. Explosion fragments account for more than half of the 5,000 objects being tracked by NORAD. Since the NORAD sensors cannot detect objects of such small sizes, their exact number in space is not known. Nevertheless, an estimate of their quantity can be made by comparison with the results of similar explosions on the ground. Most of the explosions in space were caused by the accidental ignition of small amounts of fuel remaining in used U.S. rocket stages. When certain chemicals in the rocket fuel come into contact with an oxidizer, they ignite spontaneously. Low-energy explosions of this type on the ground typically produce about 1,000 fragments, of which only 200 are large enough to be seen by NORAD radars. Thus, in all probability there are more undetected small objects in Earth orbit than objects currently being tracked by NORAD.

Low-energy explosions, however, may not be the richest source of small objects. High-energy explosions are known to produce only a few large fragments but even more small fragments than low-energy explosions. The Russian space tests of antisatellite systems, beginning in 1968, may have involved planned high-energy explosions of this type. The containers of these systems were designed to explode like hand grenades near their targeted objects, breaking into innumerable small fragments of some preferential size. A structure weighing only one hundred pounds could be broken into 10,000,000 fragments one twenty-fifth of an inch in diameter, or 10,000 fragments one-half inch in diameter in such an explosion. Thus, a single explosion of this type in low Earth orbit would hypothetically create a risk from man-made objects that is greater than the risk from meteoroids of the same size.

Less speculative is the number of fragments produced in a collision. The most probable kind of collision between two objects is that of a discarded rocket body or payload with a large fragment from an earlier explosion. If past trends continue, several such collisions are probable during the next twenty years. These high-energy fragmentations have been simulated in the laboratory. Based on the laboratory results, each collision in space is estimated to produce 4,000,000 particles larger than one twenty-fifth of an inch, and 8,000 objects larger than one-half inch. Thus, the natural collision process among orbiting

Vivaldi's 'Mandolin Concerto' Is Yours For Only $1.00

with your FREE-NO PURCHASE-OBLIGATION membership

Vivaldi's *Mandolin Concerto in C Major* is a work of such captivating beauty and universal appeal that once it is heard, the listener is almost compelled to hear it again and again. This fact was experienced by hundreds of thousands of viewers of the Academy Award winning movie *Kramer vs. Kramer*, in which this Mandolin Concerto was featured.

A brief movement from a Vivaldi mandolin concerto was played frequently for one week on a "pop" radio station. The reaction of the station's listeners was astonishing—after this exposure the disc sold some 80,000 copies! This is the record that was played by the station!!

Now you, too, can enjoy a copy of this out-of-this-world recording for only $1.00 ($2.00 for cassette) along with your FREE-NO OBLIGATION membership in the Musical Heritage Society.

GET "SELECTIONS FROM OUR MASTER CATALOG" FREE!

The Musical Heritage Society has been acknowledged as "the Nation's treasure house of obscure as well as familiar classical music."

With your introductory recording, we will include "Selections from Our Master Catalog" containing records and cassettes covering every musical period, carefully chosen from our collection of almost 3,000 records and cassettes.

The Musical Heritage Society issues each year about 200 new recordings of the music of such great masters as Albinoni, the Bachs, Beethoven, Berlioz, Buxtehude, Charpentier, Corelli, Couperin, Gluck, Handel, Haydn, Lully, Monteverdi, Mozart, Pergolesi, Purcell, Scarlatti, Schubert, Telemann, Torelli, Vivaldi, and many others. Its recordings cover all musical periods: Medieval, Renaissance, Baroque, Rococo, Classical, Romantic, and Modern. Over 200 of its recordings have been honored with the coveted GRAND PRIX DU DISQUE and other international awards.

Most of the Society's records are of works recorded FOR THE FIRST TIME! Manufactured to the highest quality standards of which the recording industry is capable, the Society's records are perhaps the finest in the country.

HOW THE SOCIETY OPERATES

The Society's recordings are not sold in stores. They are offered directly through the MUSICAL HERITAGE REVIEW magazine at three-week intervals. As a member, you'll enjoy substantial savings. Member prices are $4.95 per LP or cassette, plus postage and handling (deluxe-boxed editions and digital recordings are slightly higher).

When the Society receives your request, it sets up an account in your name and begins sending your free one-year subscription of the MUSICAL HERITAGE REVIEW for your edification and delight. There is NO PURCHASE OBLIGATION and you may discontinue the complimentary subscription at any time. As a subscriber, outstanding selections will be scheduled for shipment to you from each issue—but there is no obligation to accept them...order only those you want when you want them!

A special response form will be enclosed with each Review...and you may use it to order or reject any selections simply by mailing it by the date specified. And if you want only the scheduled selections, you need do nothing—they will be shipped to you automatically. What's more, you'll have at least 10 full days in which to make your decision—if you ever have less time than that, just return the special selections at our expense, for full credit.

Unforgettable Moments of Musical Pleasure Await You—Send for this Record or Cassette and your Free Society Membership Today!

All applications are subject to review before membership is granted.

MUSICAL HERITAGE SOCIETY *0532702
14 Park Road, Tinton Falls, N.J. 07724

Ladies and Gentlemen of the Society:
Please send me Vivaldi's MANDOLIN CONCERTI along with my FREE copy of "Selections from Our Master Catalog." You may enter my subscription to the Society's recording program and set up an account in my name. However, it is understood that I may cancel at any time, and there is absolutely no purchase obligation on my part. My payment for this order is enclosed.

SEND "MANDOLIN CONCERTI" IN THIS TYPE OF RECORDING:
☐ Record #1100, $1.00 ☐ Cassette #2217, $2.00
☑ #9037 "Selections From Our Master Catalog"

NAME ______________________

ADDRESS ______________________

CITY ____________ STATE ________ ZIP ________

Send my FUTURE selections in: ☐ Records ☐ Cassettes

OFFER OPEN TO NEW MEMBERS ONLY
Offer Valid Within the Connecting United States Only

satellites would produce a cloud of particles circling the earth. The risk to most spacecraft orbiting the planet through such a cloud would be greater than the risk from meteoroids.

Evidence of high-energy collisions occurring in nature can be found in the solar system. The small asteroids that exist in enormous numbers in the asteroid belt are believed to have originated from the collisional breakup of larger asteroids. Asteroidal collisions are thought to have caused an even greater quantity of large rocks. A small fraction of these escape from the asteroid belt and survive entry into the earth's atmosphere, qualifying as meteorites. Many recovered meteorites show evidence of having originated from such collisional processes. The major difference between collisions in the asteroid belt and collisions between artificial satellites in Earth orbit, however, is the frequency at which the collisions occur. Because the earth's orbital space is so much more crowded than the asteroid belt, collisions there will occur about a million times more often.

A final misconception about space is that what goes up must come down, or space is self-cleaning. Many of the satellites in the upper reaches of Earth orbit will never return to the earth. But most of those placed in orbits below about 300 miles, where the atmosphere is relatively dense, either burn up or come down on the earth's surface within a few years. Above 300 miles, orbital lifetimes increase rapidly. At 700 miles, most spacecraft will remain in orbit for hundreds of years. Smaller fragments are more sensitive to atmospheric drag and will reenter earlier. But since a large number of small fragments may be continually created by relatively few collisions between larger objects, the risk they represent would persist until their sources are removed.

The removal of the sources of fragments in Earth orbit is the most important means of controlling the future growth of orbital debris. NASA has already taken steps to minimize the possibility of accidental explosions in space. But an international treaty may be required to prevent intentional explosions or to restrict them to low altitudes from which the fragments would quickly reenter the earth's atmosphere and burn up. Elimination of explosions in space would also do much to slow the collisional fragmentation process. Collision rates increase as both the number and size of satellites increase, and explosion fragments currently account for a large number of objects. Most of the targets in the collision process come from the nearly 2,000 discarded rocket bodies and payloads that are at present orbiting the earth. Since there are only slightly more than 200 operational payloads in orbit, the number of collision targets could be significantly reduced without changing the number of functioning spacecraft.

Studies have been conducted by NASA during the past five years to determine the feasibility of using the space shuttle to retrieve nonfunctioning satellites. These studies show that about one-half of the orbiting satellites are reachable, but because they were not designed to be retrieved, there could be problems with harnessing them and storing them in the shuttle. In addition, only one satellite could be recovered on each launch since the shuttle does not usually have sufficient fuel to pursue and capture a second satellite. For these reasons, retrieval by the space shuttle may be too expensive.

The disposal of a space satellite is more economical when it is planned before the satellite is launched. Only a small force is required to cause a satellite to reenter the earth's atmosphere, and that force could come from small rockets added to the spacecraft. There are also conditions under which the gravitational forces of the sun and moon are sufficient to alter the orbit of an object and cause it to reenter the earth's atmosphere. To take advantage of these gravitational forces, the launch must be planned to insure that these same forces do not instead elevate the orbit to higher altitudes.

Thus, there are several procedures that could reduce the risk to future space missions from orbital debris. Some of these are expensive; others are not. But the problem must be faced. Future space structures, designed for ever longer missions, are likely to be larger and lighter and therefore even more sensitive to penetration by meteoroids and small pieces of man-made objects. Adding the weight required to protect such structures against this junk in space might well increase the cost of space activities so significantly as to make future space missions economically infeasible.

Donald J. Kessler, an astrophysicist at the Space Environment Office of NASA's Johnson Space Center in Houston, Texas, is responsible for research on controlling the growth of orbital debris.

Better Than Jogging

NordicTrack

Jarless Total Body Cardiovascular Exerciser

Duplicates X-C Skiing for the Best Motion in Fitness

Highly Effective and Pleasant To Use
The enjoyable sport of cross-country skiing is often cited as the most perfect form of cardiovascular exercise for both men and women. Its smooth, fluid, total body motion uniformly exercises more muscles and higher heart rates seem easier to attain than when jogging or cycling. NordicTrack closely simulates the same pleasant motion and provides the same cardiovascular endurance-building benefits — right in the convenience of your home. Makes a year round, consistent exercise program easily attainable. Eliminates the usual barriers of time, weather, chance of injury, etc. Also highly effective for weight control.

Better Than Running
NordicTrack gives you a more complete work out — conditions both upper body and lower body muscles at the same time. Fluid, jarless motion will not cause joint or back pains as jogging or running often does.

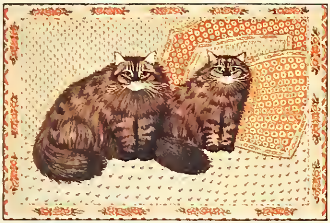
Better Than Exercise Bikes
NordicTracks stand-up skiing motion more uniformly exercises large leg muscles and also adds important upper body exercise. Higher pulse rates, necessary for building fitness, seem easier to attain because the work is shared by more muscle mass. The NordicTrack also keeps more muscles in tone.

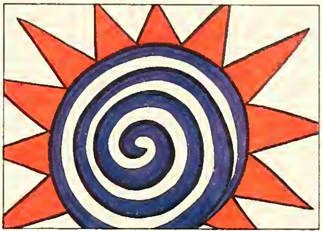
Even Better Than Swimming
NordicTrack more effectively exercises the largest muscles in the body, those located in the legs and buttocks. These muscles main function is to lift and propel the body in the standing position. When swimming, the water supports the body thus preventing these muscles from being exercised as effectively as when they support the body in a standing position as when using the NordicTrack.

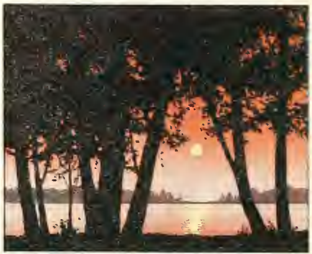
A Proven, high Quality Durable Product
Ruggedly constructed, NordicTrack is quiet, motorless and folds compactly for storage. Separate arm and leg resistances. NordicTrack is in its 5th year of production and is used in thousands of homes and many companies. We manufacture and sell direct. Our No-Risk 15 day trial guarantee shows our confidence in your being pleased with the performance and quality of the NordicTrack.

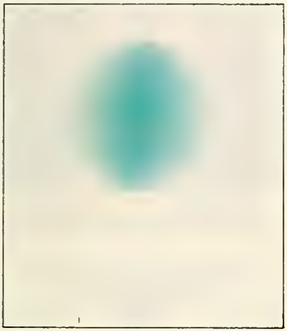
For more information, call or write
PSI 124 L Columbia ct. Chaska, MN 55318
toll free 1-800-328-5888 8 – 5 Mon – Fri
Minnesota 812-448-8987

What your home could have in common with the Met, the Tate, and the Louvre.


Mimi Vang Olsen's *Barnaby and Tulip*, original lithograph.
Signed limited edition of 275.


Alexander Calder's *L'Etoile*, original lithograph.
Signed limited edition of 75.


Wilbur Streech's *Southern Moon*, original serigraph.
Signed limited edition of 250.


Shimotakahara's *G-104, Composition of Time & Space*, original serigraph. Signed limited edition of 100.

In your own home, you can exhibit original work by artists who are represented in the world's great museums and galleries.

Artists like Calder. Chagall. Dali. Miró. Picasso. Vasarely.

At the Original Print Collectors Group, we offer moderately priced limited edition prints by these and other well-known artists.

Our offerings include signed original etchings, engravings, lithographs, woodcuts, and silkscreen prints.

Each print we offer is signed and numbered by the artist. Custom-framed. Accompanied by a certificate of authenticity and a full money-back guarantee.

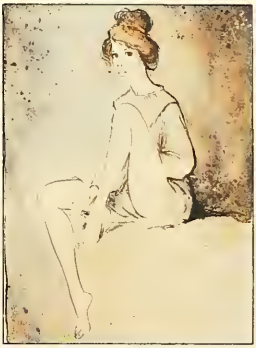
And each print has been chosen not only for its beauty but for its investment value.

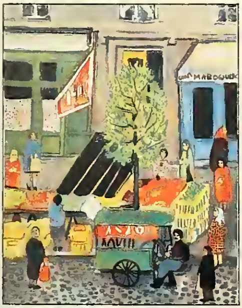
(Works by the artists we offer tend to appreciate, sometimes as much as 30% in a single year. Perhaps that's why *The Wall Street Journal*, *Business Week*, *Money*, AP, *Barron's* and UPI have quoted us as an authority on investing in art.)

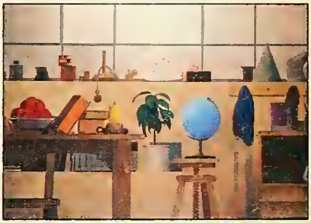
For more information, send in the coupon. There's no obligation.

You'll find out about the special pleasure of owning original art, instead of just visiting it.

Visit our new gallery located at 215 Lexington Avenue,
Mon–Fri, 9–5 PM. Telephone: 212-685-9400 Ext: 35


Bernard Charoy's *Jacqueline en Repos*, original lithograph. Signed limited edition of 300.


Nathalie Chabrier's *L'Aiguiseur*, original lithograph.
Signed limited edition of 250.


Antonio Peticov's *Golden Studio*, original serigraph.
Signed limited edition of 195.

Original print collectors group, Ltd.

215 LEXINGTON AVE., DEPT. NH-38,
NEW YORK 10016

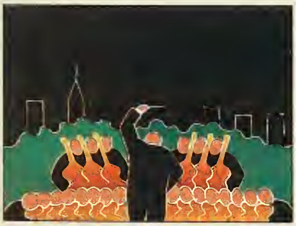
PLEASE SEND ME YOUR FREE COLOR
CATALOGUE WITHOUT OBLIGATION.

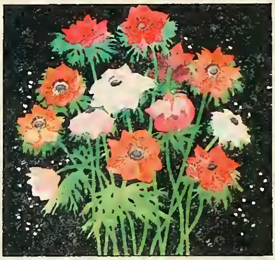
NAME ______________________ PLEASE PRINT

ADDRESS ______________________

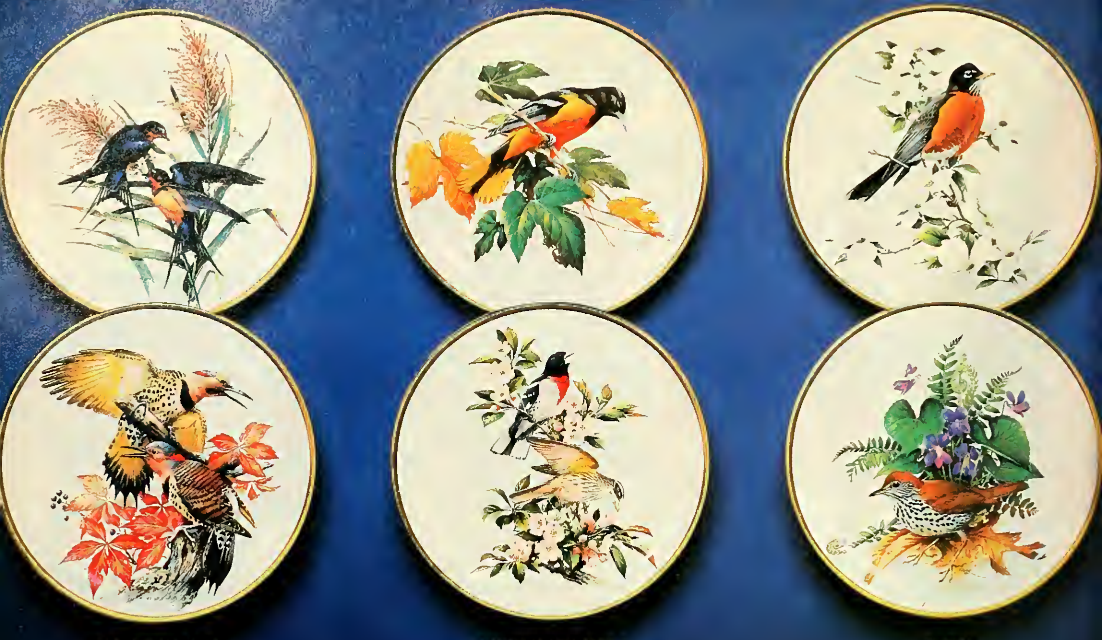
CITY ______________________

STATE ______________ ZIP ______________


Thom De Jong's *Concert in Park*, original etching.
Signed limited edition of 175.


Janet Compere's *Anenomes*, original etching.
Signed limited edition of 175.

© 1982 OPCG, LTD



BARN SWALLOW BALTIMORE ORIOLE ROBIN

FLICKER ROSE-BREASTED GROSBEAK WOOD THRUSH

American Express® Announces
the *first* porcelain plate collection by the world's greatest bird portraitist.

THE SONGBIRDS OF ROGER TORY PETERSON PORCELAIN PLATE COLLECTION

Available only by subscription to both American Express Cardmembers and Non-Cardmembers.
Advance Subscription Deadline: April 30, 1982.

These may be the most beautiful bird plates ever issued...and the most important that ever will be issued.

THE ARTIST

Roger Tory Peterson is recognized as the world's greatest living bird-painter and ornithologist. His *Field Guides* and bird paintings have been the subject of feature articles in *Time*, *Reader's Digest*, *Parade*, *Audubon Magazine*, *Smithsonian*, *National Wildlife*, *The American Artist*, and scores of other publications. His works are avidly sought after by connoisseurs and collectors.

The world has lavished honors upon him. He has received eleven honorary degrees. And among his most prized awards are the Gold Medal of the World Wildlife Fund ...the Audubon Conservation Medal...the Gold Medal of the New York Zoological Society...the Linnaean Gold Medal, which was presented personally by the King of Sweden...and the Presidential Medal of Freedom—the highest civilian honor the United States can bestow.

Peterson has devoted his entire life to the study and painting of birds. Not since the finest work of John James Audubon has there been such a masterful fusion of artistic beauty and absolute accuracy in bird portraiture.

Now, for the very first time, you have the opportunity to acquire Roger Tory Peterson's magnificent art in fine porcelain —in *The Songbirds of Roger Tory Peterson Porcelain Plate Collection*. An extraordinary series of twelve collectors' plates capturing the very *essence* of the beauty of birds in their natural habitat.

Each of these twelve plates is an outstanding work of art in itself. Together, they form an incomparable collection—an important acquisition for everyone who loves the beauty of birds, of fine porcelain and of inspired art. In the home, they will be a continuing delight—a proud display and a subject of interest and admiration.

THE PLATES

To ensure that the collection is worthy of the magnificent art it bears, *The Songbirds of Roger Tory Peterson Porcelain Plate Collection* will be crafted in France by the world-renowned firm of Porcelaine Georges Boyer of Limoges. The whiteness and translucence of fine Limoges porcelain, treasured for

ADVANCE SUBSCRIPTION APPLICATION
Valid only if postmarked by April 30, 1982.
Limit: One collection per subscriber.

THE SONGBIRDS OF ROGER TORY PETERSON
PORCELAIN PLATE COLLECTION.

Please enter my subscription for The Songbirds of Roger Tory Peterson Porcelain Plate Collection in fine Limoges porcelain rimmed with pure 24 Karat gold. I need send no payment now. The twelve plates are to be sent to me at the rate of one plate every other month. I will be billed for each plate in two monthly installments of $24* with the first payment due in advance of shipment.

Indicate desired means of payment:
☐ American Express Card ☐ Check or Money Order

To charge your order to the American Express Card, call free of charge, 1-800-528-8000.

Signature ____________________
Please Print Clearly:
Name ____________________ NH2
Address ____________________
City ____________________
State ____________ Zip ________

American Express Company, American Express Plaza, NY, NY 10004.

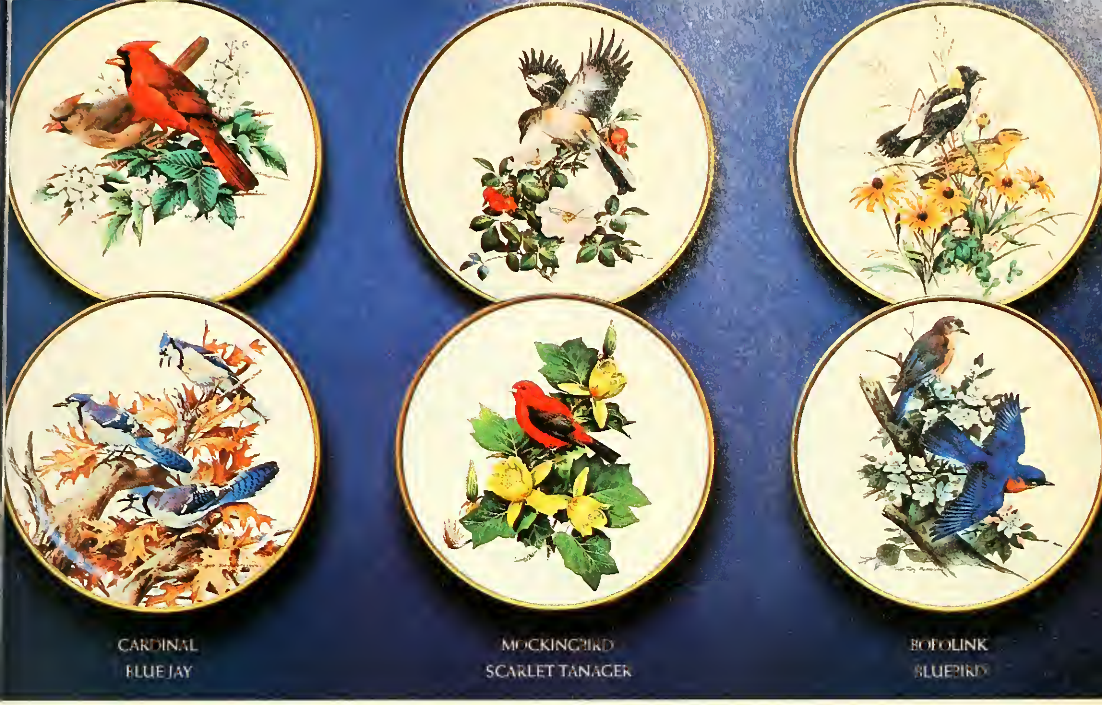
* Plus applicable tax added to the first payment. Plus $2.95 shipping and handling charges.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 110 NEW YORK, NEW YORK

POSTAGE WILL BE PAID BY ADDRESSEE

AMERICAN EXPRESS COMPANY
P.O. Box 670
New York, N.Y. 10276



CARDINAL
BLUE JAY

MOCKINGBIRD
SCARLET TANAGER

BOBOLINK
BLUEBIRD

Actual size of each plate is 9¾" in diameter.

centuries as the very finest in the world, enhance each subtle color and fine detail of Peterson's art.

And in order to provide full scope for Roger Tory Peterson's first works in porcelain, the plates will be exceptionally large—a full 9¾ inches in diameter.

In addition, as the perfect complement to Peterson's art, each plate will be hand-decorated with a band of pure 24 Karat gold around its rim. And as many as 20 separate and distinct ceramic colors will be utilized so that Peterson's wonderfully natural bird portraits can be captured perfectly in the medium of fine art porcelain.

The beauty of the collection...its quality...and its unique status as Roger Tory Peterson's first work in porcelain—all combine to make this an issue of exceptional importance. A collection to be prized and treasured and enjoyed—now and for generations to come.

ISSUED IN LIMITED EDITION

There will be only one edition of *The Songbirds of Roger Tory Peterson Porcelain Plate Collection*. This will be a limited edition with a final closing date of December 31, 1982, and available only by subscription and with a limitation of one set per subscriber.

As is traditional for important issues of fine art porcelain, the collection will be available for only this limited period of time and will then be closed permanently, never to be issued again.

Since not even the finest art dealers or galleries will be able to offer these plates for original sale, the opportunity to subscribe is especially significant. You can do so by returning the accompanying Advance Subscription Form by its stated expiration date of April 30, 1982.

THE SUBSCRIPTION PLAN

As a subscriber, you will receive one plate every other month. The original issue price of just $48 per plate is payable in two convenient monthly installments of $24 per month. With your collection, you also receive a Certificate of Authenticity verifying the fact that it is issued in a limited edition.

Since there may be subsequent announcements of *The Songbirds of Roger Tory Peterson Porcelain Plate Collection* before the edition is permanently closed at the end of 1982, subscriptions will be filled on a first-come, first-served basis. And, because plates of this quality take time to produce, a limited number are now available. Therefore, the application is valid only if postmarked by April 30, 1982.

This may well be the most beautiful collection of bird plates ever issued...or that ever will be issued. And as Roger Tory Peterson's first work in porcelain, it will always have a special importance. Since earliest orders received will be the first to be fulfilled, please be sure to mail your subscription application no later than April 30, 1982. To charge your order to the American Express Card, call free of charge, 1-800-528-8000 by April 30, 1982.

ADVANCE SUBSCRIPTION APPLICATION

Valid only if postmarked by April 30, 1982.
Limit: One collection per subscriber.

AMERICAN EXPRESS COMPANY
PO BOX 670
NEW YORK, NY 10276

Please enter my subscription for *The Songbirds of Roger Tory Peterson Porcelain Plate Collection* in fine Limoges porcelain rimmed with pure 24 Karat gold.

I need send no payment now. The twelve plates are to be sent to me at the rate of one plate every other month. I will be billed for each plate in two monthly installments of $24.00* with the first payment due in advance of shipment.

Indicate desired means of payment:

☐ American Express Card.
☐ Check or Money Order.

Signature ____________________

Please Print Clearly:

Name ____________________

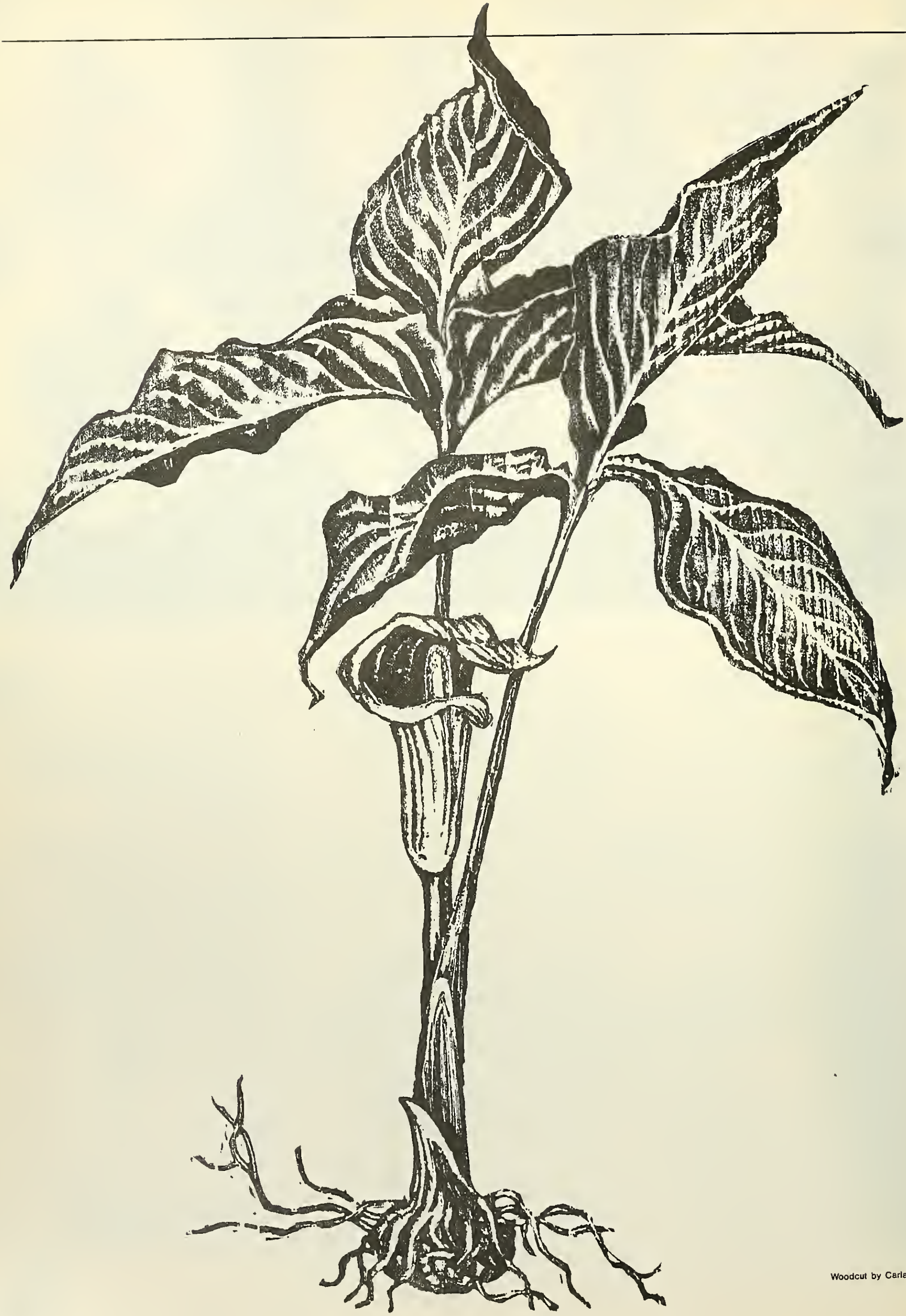
Address ____________________

City ____________________

State ____________ Zip ____________

* Plus applicable tax added to the first payment. NH1
Plus $2.95 shipping and handling charges.

American Express Company, American Express Plaza, NY, NY 10004



Woodcut by Carla Bauer

Jack and Jill in the Pulpit

For some small plants, the burden of being female is just too much to bear

by Paulette Bierzychudek

Jack-in-the-pulpit, *Arisaema triphyllum*, is a perennial forest herb that is endowed with one of the rarest of all plant breeding systems. During each flowering season, a jack-in-the-pulpit plant behaves like a member of one sex or the other, producing either male or female flowers. Plants are not fixed as males or females for their entire lives, however, and an individual has the option each year of performing as a member of either sex. This breeding system, more common in animals than in plants, has been termed sequential hermaphroditism. In common parlance, jack-in-the-pulpit can change sex: "Jack" can become "Jill," and vice versa.

Common in the understory of deciduous forests throughout the eastern half of the United States from Maine to Florida, jack-in-the-pulpits thrive in moist, species-rich woods. They come into bloom just as the canopy is leafing out in the spring, somewhat after the peak of the wildflower display. Each plant produces one or two deep-green, tripartite leaves. A stalk bearing a tall, graceful pulpit, or hooded inflorescence, grows from the junction of the leaves. The pulpit, a complicated structure characteristic of the arum family, Araceae, consists of many flowers surrounded by a modified leaf called a spathe. This leaf may have a variety of color patterns, ranging from solid green to green with longitudinal stripes of sharp white or exotic purplish brown.

The spathe surrounds and forms a hood over a columnar spadix, a fleshy spike whose base is covered with dozens of tiny, simple male or female flowers. Each male flower is a cluster of creamy white or purplish anthers, which open to release large quantities of pollen; the pollen then collects at the base of the chamber created by the spathe. Female flowers are green spherical structures, each topped by a stigma and containing several ovules, or potential seeds.

Pollen is carried from male to female flowers by tiny fungus gnats that flit from plant to plant. Hardly the traditional pollinator, these flies possess no special structures for the transport of pollen, but a few grains cling to their sparse coats of hairs and bristles. Jack-in-the-pulpits, for their part, have none of the attractive devices normally associated with pollinator reward—no nectar or bright color, for example. They apparently attract fungus gnats by means of deception. Something about the inflorescence—its color or odor—may resemble the mushrooms on which fungus gnats mate and lay eggs. Once they have flown into the open top of the spathe, the flies are trapped, unable to fly in the narrow chamber or to walk up the smooth walls.

A subtle sexual dimorphism in jack-in-the-pulpits makes pollen transfer from males to females possible. On male plants, where the spathe overlaps itself at the base of the chamber, there is a gap just large enough to allow the gnats to escape and carry some of the male's pollen with them. The spathe of each female inflorescence overlaps smoothly, leaving no escape hole. By the end of the flowering period the chambers of most female pulpits contain dead gnats. The pulpit "traps" bear some resemblance to the traps of such insectivorous pitcher plants as *Darlingtonia* or *Sarracenia*, but there is no evidence that jack-in-the-pulpits absorb any nutrients from the trapped flies. The trap simply seems to insure that the flies will thrash around in the chamber long enough to lose any pollen they might be carrying.

During the course of the summer, the fruits of successfully pollinated flowers enlarge within the spathe's covering. Eventually the swelling berries become large enough to burst out of the enclosing leaf, and by late summer they begin to turn red. Ripe berries contain one to several seeds in a watery, sweetish matrix surrounded by a bright scarlet skin.

Herbivory is not a serious problem for jack-in-the-pulpit since the leaves and the corm (thick, underground stem) contain crystals of calcium oxalate, a mechanical irritant that deters a wide range of potential herbivores, mammals and insects alike. Only snails and slugs, apparently resistant to the effects of the crystals, feed on the foliage with any regularity. The damage they do is minor, however, and usually occurs at the end of the growing season, when foliage is already beginning to die back for the winter. *Arisaema*'s most serious enemy is a rust, a fungus disease that arrives via airborne spores and spreads throughout the plant, causing the development of deformed leaves and inflorescences, interfering with photosynthesis, and causing early senescence and eventual death.

A perennial, *Arisaema* grows slowly,

A MAGAZINE
FOR YOUR
PIANO

Keyboard Classics Magazine *takes up where* ***The Etude*** *magazine left off. Filled with musical treasures, fancies and delights to be played on your piano, it is truly the one magazine you will enjoy again and again.*

◆

*Available only by subscription.
Write To: Keyboard Classics,
Dept. A1-19-32, 352 Evelyn Street,
Paramus, NJ 07652.
Enclose $9.97 for a full year's
subscription (6 issues).
Completely refundable if you are not
delighted with your first issue.*

probably because of the low levels of light available in the forest understory. Large (knee-high) plants may be twenty or more years old. At the end of a summer, a plant's one or two leaves are the same size as when they developed in the spring, and no new ones have been added. Instead of being used to form new leaves, the sugars formed by photosynthesis over the course of the season are stored as starch in the underground corm, providing fuel reserves for next season's leaf or leaves and inflorescence. By the end of the growing season, the plant has made certain developmental "decisions," presumably on the basis of the amount of stored material: whether to produce one or two leaves and whether to produce a male or female inflorescence or none at all. If a corm is removed from the ground in September and dissected, leaf and inflorescence organs can be seen, and the sex of next year's flowers easily identified.

Upon examination, these dormant corms reveal a clear pattern, one that is also evident when inspecting flowering plants in the spring. Large, two-leaved plants almost invariably bear female inflorescences; smaller, one-leaved plants usually behave like males; and the smallest plants produce no inflorescence at all. This pattern is so striking that a person with some experience can accurately predict the sex of most plants from several yards away on the basis of their size alone.

If a medium-sized male plant has a profitable year, from a photosynthetic standpoint, then in the fall it will produce primordia for two large leaves and a female inflorescence. If, however, it has managed only to replace the reserves it used from last year, but not to add to them, the plant will once again form male flower primordia and only one leaf. And if the plant has had a particularly bad year—if, for example, it was cut down or trampled not long after emergence—it is likely not to flower at all in the succeeding year. No state is irreversible, and a new decision is made every year. Even a very large female plant that has suffered severe damage for several years running can be induced to produce smaller leaves and to flower as a male. With time and good conditions, the plant is likely to regain its large size and female status. Sex change among jack-in-the-pulpits is far from a rare phenomenon. In successive years, as many as 50 percent of all the plants large enough to produce flowers switch from one sex to the other.

Why are there no females among the

small plants and no males among the large ones? The relationship between the size of plants and their sex provides some clues about the possible reason for the evolution of this sex-changing behavior. The pattern of large females and smaller males is not uncommon in the animal kingdom and is thought to be an adaptation related to the greater reproductive effort, or cost, that females must sustain. An egg usually contains a larger supply of nutrients and stored energy than does a sperm. In addition, females often carry and nourish developing embryos in their bodies for an extended period of time, and they are more likely than the males to engage in the care and feeding of the offspring after birth. For these reasons, large size is advantageous for females. Males can also be subject to selection for large size, especially in species where competition for females is involved, and this can reduce male–female size differences. Even in these species, however, females must often be larger than males before they achieve sexual maturity.

Among plants, the costs of reproduction may also be greater for females than for males. To test this hypothesis, I measured the reproductive effort of male and female jack-in-the-pulpits, using the weight of each plant part as an estimate of the amount of energy required for its production. A male inflorescence tends to represent a fairly constant proportion of a plant's total biomass, about 8 percent. Because this structure withers and disappears soon after the flowering period, it does not have to be supported by the plant for very long.

The story is different for females. After flowering, females must also supply the developing embryos with food (endosperm), protection (seed coat), and fruit flesh to attract potential seed dispersers—all over the course of the growing season. Thus, while a female inflorescence alone is no more costly to produce than a male one, the cost rises if seeds are produced. Furthermore, jack-in-the-pulpit seeds are large and heavy, and seed size is constant rather than flexible, so the cost of producing a set number of seeds will always be greater for a small plant than it is for a large one. The production of five seeds, for example, represents a reproductive effort of as little as 10 percent for a very large female and about 20 percent for an average-sized female. Extrapolating from the mathematical relationship between plant size and reproductive effort, I have predicted that if a tiny plant the size of a male were to function as a female, the production of five seeds would entail a reproductive effort of 30 percent.

Other perennial species of forest herbs average a reproductive effort of about 5 percent. For reasons that are not clear, jack-in-the-pulpits expend considerably more energy than this on reproduction—8 percent for males, 10 percent or more for fruiting females. A reproductive effort as high as 30 percent is seen only in a few species of annuals, which die at the end of the growing season. Presumably, no perennial plant could invest 30 percent of its biomass in reproduction and still have sufficient reserves for surviving the winter and producing new leaves the following spring.

In the face of this high cost of female reproduction, sex changing is probably a better option than dioecism, the condition of having individuals with separate, fixed sexes. If jack-in-the-pulpit were to behave as a typical dioecious plant, the males would attain flowering size after only a few years, but the females would need to wait many years before they became large enough to flower and pro-

KAHLÚA®
&
cream
KAHLÚA
IMPORTED
FROM SUNNY MEXICO
KAHLÚA
LICOR DE CAFÉ
COFFEE LIQUEUR
"frrresh"

One of the most naturally delicious drinks imaginable: an ounce of Kahlúa, four ounces of cream, or milk, over ice. And, since you make it yourself, a taste as frrresh as can be. The Kahlúa recipe book tells all. Do send for it. Our treat. Maidstone Wine & Spirits Inc. P.O. Box 8925, Universal City, CA 91608.

© 1981 Kahlúa Imported Liqueur 53 Proof

Get a solid 24K Gold Swiss Ingot for 49.99

CREDIT SUISSE
1 g
FINE GOLD
999.9
25241

Enlarged to show detail.

This offer is limited to United States residents only; your mailing address must be within the 50 states. Each 1 gram ingot is a solid bar of pure 24 karat gold of 999.9 fineness, hand-set in a frame of polished Black Onyx, individually numbered and authenticated by the Credit Suisse Bank of Zurich, Switzerland, and accompanied by the Bank's Certificate of Authenticity to that effect.

FREE GOLD CHAIN: If your request is postmarked before May 25, we will include a solid 14 karat gold chain, free of charge, so that you may wear the ingot around your neck. This 16-inch chain comprises 350 links of solid 14 karat gold. You may return your gold ingot at any time for a refund, *but the 14 karat gold chain remains yours to keep regardless.*

Swiss Gold Marketing Council, Ltd.,
Dept. 569-18, Box 256, Jericho, N.Y. 11753

GENTLEMEN: Please send_____ (how many?) 24 karat gold Swiss Ingot(s) for only 49.99 each. (A86220)

Total of $_________ enclosed.

Add 2.00 insurance, shipping and handling for each gold ingot. (N.Y. residents add sales tax.)

☐ Or charge to my ☐ VISA ☐ MASTER CARD

Card # ________________ Exp. Date _______

Name ________________________

Address ______________________

City _________________________

State ____________ Zip ____________

© 1982 Swiss Gold Marketing Council, Ltd

duce seeds. Because mortality chances are high for small plants, few females would survive to reproductive size. Sex changing allows plants to reproduce sooner and more often; they can be fathers whenever they are too small to be mothers.

Comparing the relative merits of sex changing and dioecism may be of little help in understanding the origin of jack-in-the-pulpit's reproductive behavior, however, since sex changing appears to have evolved, not from dioecism, but from a monoecious condition in which individual plants produce both male and female flowers. While dioecism is unknown in the family Araceae, monoecism is extremely common.

The genus *Arisaema* is a large one, containing more than a hundred species, most of them native to the temperate and semitemperate forests of China, Japan, and India. In some species, an individual reproduces as a male when it is small, but as the plant grows larger, its inflorescence contains first a few and then, with each succeeding year, more and more female flowers. Even the largest plants, though, bear male as well as female flowers. Developmentally, these plants begin life as males and eventually become monoecious.

The reproductive strategy of some other species comes closer to that of *Arisaema triphyllum.* The plants in this second group pass through three size-related stages: male, monoecious, and female. Finally, the majority of the species have a reproductive strategy like *Arisaema triphyllum*'s; here the monoecious stage has been entirely eliminated. While the phylogenetic relationships within this rather large genus are still unclear, it seems safe to assume, on the basis of the reproductive biology of the rest of the family, that the sex-changing species represent an evolutionary advance over the monoecious ones.

Whether the loss of the monoecious stage carries with it a selective advantage and, if it does, what that advantage might be are not clear. No information is available about whether the monoecious species of *Arisaema* are capable of self-fertilization. Certainly, self-fertilization is impossible for members of this third group; jack-in-the-pulpit females can never produce seeds unless pollen from a separate male plant arrives via fungus gnats. There are several possible advantages to avoiding self-fertilization, but in jack-in-the-pulpit, these theoretical advantages must be weighed against a clear disadvantage—the meager seed production of females in some locations. Although a typical female has thirty to fifty flowers and each flower contains four to six ovules, the average plant at my study sites in upstate New York produced fewer than ten seeds per year. Many plants produced no seeds at all. This poor performance is not a result of energetic constraints: when I pollinated jack-in-the-pulpits by hand with a camel's-hair brush, using pollen from neighboring males, these same females regularly produced from fifty to two hundred seeds. *Arisaema*'s pollinators appear to be so inefficient and unreliable that the probability of fertilization for any individual female flower is extremely low.

I was surprised by this finding; pollinators rarely limit the seed production of plants so severely. But jack-in-the-pulpit and its fungus gnats are different from the stereotypic flower and its faithfully cooperative pollinator partner. Since flies receive no reward for pollinating jack-in-the-pulpit flowers and will die in female pulpits, natural selection favors flies that are the least effective and efficient pollinators; these are the ones that will survive to mate and lay their eggs. Any fly that successfully transports pollen from a male to a female inflorescence dies without reproducing, and any genes that might influence that propensity are lost from the fungus gnat gene pool. How, then, could anything but a haphazard, chancy relationship between *Arisaema triphyllum* and its pollinators be expected? The obvious solution would be for *Arisaema* to modify its pollination syndrome in order to attract the services of more effective pollinators. Why has this not occurred?

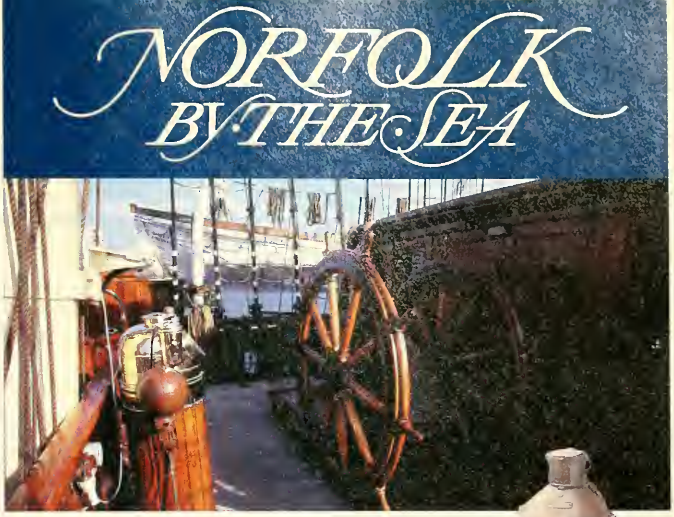
Before I can begin to answer this question, more information is needed. Do all *Arisaema* species exhibit the same degree of pollinator limitation or is *A. triphyllum,* one of only two *Arisaema* species in North America, exceptional in this respect? Perhaps jack-in-the-pulpit has not always been so poorly pollinated. Fungus gnats may be less common today than in presettlement days, now that the forest that once covered all of eastern North America exists only as small patches. If this relatively recent environmental change has lowered jack-in-the-pulpit's seed production, adaptive modifications may occur with time and seed set may improve. If, however, jack-in-the-pulpit's behavior is different from that of its Asian relatives, and has been for a long time, then the meager seed production suggests that evolution may have a difficult time revamping a basic plan once it has become established. *Arisaema*'s reproductive behavior does seem conservative: all the species that have been studied are pollinated by tiny flies, and all possess inflorescences very similar in structure to those of *A. triphyllum.*

Before Darwin's time, natural historians believed that the components of the natural world were all part of a master plan. They expected efficiency and perfection of design, sought examples of such efficiency, and marveled at the wisdom of Providence when they found them. In more recent times, we have sometimes had a similar regard for natural selection. We often expect to find organisms that are perfectly adapted to their environments, and certainly many of them seem to be, sometimes in amazing ways. The leaf-mimicking butterfly, complete with insect damage, and the provisioning by some acacias of special nectaries and food bodies for their ant protectors are examples of the power of natural selection. But natural selection operates under various constraints that can sometimes prevent the attainment of the optimal design.

First, because no year is exactly like any other year, no environment exactly like any other environment, there may be no one "best" design. The design that natural selection favored at one time or in one particular place is unlikely to be perfectly suited for that environment forever or once the organism has dispersed to a new place. Second, drawing the theoretically best design from a species' limited genetic repertoire may not be possible. Genes with unrelated functions may be closely linked, making it impossible for selection to improve on one aspect of an organism's design without interfering with another. Finally, when a structure or a behavior is being modified by natural selection for a new function, a total overhaul is never possible. The old design must be altered to serve the new role, and such remodeling is unlikely to result in the most efficient, streamlined form conceivable.

Some such constraint may be responsible for jack-in-the-pulpit's low levels of seed production. Reconstructing the coevolutionary history of the jack-in-the-pulpit and the fungus gnat may prove elusive, but the plant's apparent maladaptiveness appears to be a testimony to the often overlooked limitations of natural selection.

Paulette Bierzychudek is an assistant professor in the Department of Biology at Pomona College.



The love affair has lasted for 300 years, a romance between a fascinating old city and the silver sea that surrounds her. Together they've known the flash of cannon fire and the birth of nuclear sub. They've produced great seafood and Grand Opera. Azaleas at water's edge, and harbor cruises on a moonlit bay.

Join us this year for our 300th anniversary celebration. For a free 40-page Visitors Guide, call toll-free 1-800-368-3097 or write Norfolk Convention & Visitors Bureau, Monticello Arcade, Norfolk, Va. 23510.

Now available with optional wooden floorboards!
SEA EAGLE 8

The Quality Alternative to High-Cost Inflatable Boats!

Why pay $600. to $1000. or even more for an inflatable boat?
Sea Eagles pack small, last for years and cost $110. – $540.
Canoes, dinghies and motormount boats for fishing, river running, camping and yacht tending.

Sea Eagle 8, shown: • 9'7" x 4'6" • 31 lbs. • Holds 4 adults • 3 hp capacity • Costs $220.

Write for our FREE brochure: Sea Eagle, Dept. NH3B, St. James, NY 11780
Or phone:
516-724-8900, 8:30 AM to 4:30 PM EST.

SEA EAGLE

FISHWATCHING IN HAWAII!!

A lively, unique guide for the snorkeler, diver, nature lover, and fish hobbyist. The book is indispensable for the visitor to Hawaii & also presents, for the first time in a layman's publication, a wealth of often startling information about fish behavior. Extensively illustrated by leading artists in the field.

Send your check & the coupon to:

Natural World Press
Suite 246, Baldwin Ave.
San Mateo, CA 94401

Please send me ___ copies of *Fish Watching In Hawaii* at $9.95 each (California residents add 6% sales tax.) Postage will be paid by the publisher. **(Code A)**

Name __________

Address __________

City __________

State __________ Zip ______

The 1982 NATURAL HISTORY Photographic Competition Is Open for Entries

The Grand Prize for the 1982 Natural History Photographic Competition will be an eleven-day trip to the Galápagos Islands, the volcanic archipelago that lies in the Pacific Ocean 600 miles off the coast of Ecuador. The prize, worth more than $2,500, includes airfare from New York, a stay in highland Ecuador, and a berth on the yacht *Buccaneer.* A living laboratory for the study of natural history, the Galápagos Islands are renowned for the influence they had on Charles Darwin and the development of evolutionary theory. The islands' exotic birds and reptiles—many unique to the area—are remarkably tame; our Grand Prize-winner can look forward to a rare opportunity to record wildlife at close range. Three Museum scientists will introduce the biological and geological features encountered during this American Museum of Natural History Discovery Tour.

First Prizes of $500 each will be awarded in the contest's five categories: Animals (including birds and bugs); Plants and Their Environment; The Human Family; A Sequence in Nature (up to five photographs); and Humor in Nature. Ten Honorable Mentions of $100 will be selected from all entries.

In addition, the designer and the editor of *Natural History* will choose a special $500 Cover Photograph Award for the July 1982 issue. Strong design, wide appeal, vertical format, and space for the magazine's logo will be among the points considered for this award.

The winning entries will be published in the July issue of *Natural History* and exhibited at the American Museum of Natural History. All winners will receive certificates of their awards, suitable for framing.

The 1982 *Natural History*
Photographic Competition
—Official Entry—

Name ____________________
Address ____________________
____
____
Phone ( ) ____________________

For office use

Logged in:
____
date initials

Returned:
____
date initials

List all photographs entered, including each item in a sequence:
number: ______transparencies
number: ______prints
total: ______

THE RULES

1. The competition is open to everyone except employees of the American Museum and their kin.

2. You may submit a total of up to five entries, in any combination of the categories (a sequence is considered a single entry). The photographs must have been taken by you and not have been published before.

3. The Museum acquires the right to publish, exhibit, and use for promotion the winning photographs. The Museum assumes no responsibility for entries.

4. Entries may be transparencies or prints, either color or black-and-white, up to 8 by 10 inches. Each must bear the photographer's name and address. Entries must *not* be mounted in glass.

5. Please enclose the official entry form (or a 3- by 5-inch facsimile), with your name, address, phone number, and total number of photographs submitted.

6. A self-addressed, stamped envelope must accompany your entries for them to be returned.

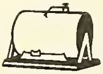
7. Entries must be postmarked no later than April 1, 1982.

Pack them carefully and mail them to:
Natural History Photographic Competition
11 West 77th Street
New York, New York 10024

And good luck!

For 10 days
FREE
EARTHQUAKE
introduces you to
PLANET
EARTH
BONUS
World-wide
Disaster Map
FREE
Yours FREE with Earthquake if you draw a zigzag line on the seismograph symbol at the right, above. Fascinating! Includes U.S. earthquake and volcano zones and much more

MAIL TODAY!



DGBV06

YES, I would like to examine *Earthquake*. Please send it to me for 10 days' free examination and enter my subscription to PLANET EARTH. If I decide to keep *Earthquake*, I will pay $9.95 ($11.95 in Canada) plus shipping and handling. I will then receive future volumes in the PLANET EARTH series, shipped one at a time approximately every other month. Each is $9.95 ($11.95 in Canada) plus shipping and handling and comes on the same 10-day free-examination basis. There is no minimum number of books that I must buy, and I may cancel my subscription at any time simply by notifying you. If I do not choose to keep *Earthquake*, I will return it within 10 days, my subscription for future volumes will be canceled, and I will be under no further obligation. DGBWC9

Name______________________
(Please Print)

Address______________________Apt.______

City______________________

State or Province______________________Zip or Postal Code______

All orders subject to approval:
Canadian residents, please mail form in envelope.

NATURAL HISTORY

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 22 CHICAGO, ILL

POSTAGE WILL BE PAID BY ADDRESSEE

TIME
LIFE
BOOKS
Time & Life Building
541 North Fairbanks Court
Chicago, Illinois 60611

NEW!

ANNOUNCING

the exciting new way to explore our world of volcanoes...killer earthquakes...raging storms

PLANET EARTH

TIME
LIFE
BOOKS

EARTHQUAKE Fleeing for their lives, residents of a Japanese city dash across heaving pavement in one of the most astonishing photographs ever taken of a quake actually happening.

VOLCANO Spectacular formations of columnar basalt, once thought to be petrified bamboo forests, are actually ancient lava flows.

TORNADO You'll learn what gives a twister the power to explode buildings.

A REAL FAMILY VALUE
Approximately 176 pages. Exciting, fact-filled 50,000-word narrative. More than 140 superbly reproduced illustrations in large 9¼" x 11⅛" format—many in full color. Matched hardcover bindings.

VOLCANO
EARTHQUAKE
STORM
EARTHQUAKE
FLOOD
Reverberations from Colliding Continents

What is it like to see huge fissures suddenly gape in your front yard? To witness the eruption of a volcano firsthand? To watch a tidal wave come roaring at you?

Now, as your introduction to a major new library from the Editors of TIME-LIFE BOOKS—PLANET EARTH—explore the volume *Earthquake* for a vivid glimpse of earth's most awesome event.

As gripping as a battle report, *Earthquake* is an enthralling learning experience. It takes your family to the places where earthquakes hit again and again. And explains why they happen. You'll be present as major quakes strike Japan and California...as Alaska cracks open on Good Friday, 1964. *Earthquake* shows you how scientists are working to predict these cataclysms...how to interpret an earthquake's "P" and "S" waves...even the five warning signals to watch for in water wells. You can go on to fascinating questions in *Volcano:* What did we learn from Mount St. Helens? When will it happen again? In *Storm:* What causes the vast weather systems that give birth to typhoons, tornadoes, hurricanes? In *Glacier*...*Flood*...*Underground Worlds*—volumes that examine the forces shaping the earth and creating its riches.

You'll find riches in each superbly detailed volume of the new PLANET EARTH library. A wealth of dramatic full-color photographs and explanatory diagrams. Fast-paced and authoritative text. Exactly what you've come to expect from TIME-LIFE BOOKS—for less than the price of most of today's best sellers. We invite you to discover a world you've never seen. Mail the card today!

Time-Life Books, Time & Life Bldg., Chicago, IL 60611

© 1982, TIME-LIFE BOOKS INC.

The world opens up for you in

EARTHQUAKE

for 10 days FREE

MAIL TO: TIME-LIFE BOOKS
Time & Life Bldg., Chicago, IL 60611

YES, I would like to examine *Earthquake*. Please send it to me for 10 days' free examination and enter my subscription to PLANET EARTH. If I decide to keep *Earthquake*, I will pay $9.95 ($11.95 in Canada) plus shipping and handling. I will then receive future volumes in the PLANET EARTH series, shipped one at a time approximately every other month. Each is $9.95 ($11.95 in Canada) plus shipping and handling and comes on the same 10-day free-examination basis. There is no minimum number of books that I must buy, and I may cancel my subscription at any time simply by notifying you. If I do not choose to keep *Earthquake*, I will return it within 10 days, my subscription for future volumes will be canceled, and I will be under no further obligation.

DGBWC9

Name________________________
(Please Print)

Address____________________ Apt._____

City________________________

State or Province____________ Zip or Postal Code____________

All orders subject to approval.

The Nature of Lichens

Algae appear to gain nothing by being part of a lichen and have to combat aggressive fungal partners just to stay alive

by Vernon Ahmadjian

The great Swedish botanist Carl Linnaeus did not think much of lichens. He dismissed them as the poor trash of the vegetable kingdom. Had he known them better, he might have held them in higher esteem, but at that time (the middle of the eighteenth century), no one understood the true nature of these hardy, long-lived pioneers of barren soil, rock, and bark. More than 20,000 species of lichens have now been identified, and they are known to grow in almost all of the earth's environments—including completely within Antarctic rocks. Yet even today, the fungi and algae that make up lichens have not revealed all their secrets.

The true nature of a lichen is not obvious. What looks like a single plant is actually a highly integrated symbiotic association of up to millions of microscopic algal cells enmeshed within a framework of fungal filaments, or hyphae. In all but the most primitive lichens, the symbiosis stimulates the fungus to form a thallus, the body of the plant. In many cases, the thallus contains specific chemical compounds that cannot be synthesized by either of the symbionts alone.

Some lichens have crustose thalli that adhere tightly to the substratum. In others, the thalli are fruticose (upright) or hanging and filamentous. Many species have foliose, or leafy, thalli that consist of four major parts: an upper cortex, an algal layer, a medulla, and a lower cortex. The upper cortex is a protective layer made up of fungal cells that cover the surface of the thallus. The algae are spread in a layer directly below the upper cortex to insure that they obtain optimum light for photosynthesis. Beneath the algal layer is the medulla, a relatively thick storage area consisting of loosely woven hyphae. Finally, there is another protective layer, the lower cortex, from which emerge rhizines that attach the lichen to its substratum. Both unicellular and filamentous algae occur in lichens. Algae that are normally filamentous are usually broken down into single cells in a thallus, and each cell is then enveloped by the fungus.

Lichens were described and named long before their symbiotic nature was discovered. There had been tentative suggestions that lichens might be more than individual plants, but the starting point for modern lichenology was set in 1867 when Simon Schwendener boldly stated to the Swiss Naturalists' Club that all lichens were associations of fungi and algae. Schwendener was a meticulous scientist whose earlier anatomical and developmental studies gave him insight into the true nature of lichens. His theory was not readily accepted, however, because lichens had been studied for too long as individual plants. Like most novel ideas in science, this one had to survive a period of controversy and condemnation. The main argument of the critics was a good one: if lichens are dual organisms, then prove it by taking them apart and putting them together again. Schwendener and his supporters tried to synthesize lichens but were only partly successful. Eventually the composite nature of lichens was realized, not from synthesis experiments, but from studies, such as those by Octave Treboux in 1912, that cultured the algal symbionts and found they were similar to free-living algae.

Lichenologists also disagreed on the relationship of the algae and fungi of lichens. Schwendener and his supporters felt that lichens were fungi that parasitized algae. The famous mycologist Heinrich Anton de Bary and others maintained that the association in lichens was one of mutualism—a union from which both partners benefit. They believed that the algal symbiont of a lichen provided carbohydrates, nitrogen, and other nutrients to the fungus and, in return, received water, minerals, and protection from environmental extremes. It was an idyllic relationship, a perfect partnership forged by evolution. Unless they were mutually supportive, how could these associations survive in areas where few other living forms could grow? This view of lichens caught the imagination of most scientists and is the more popular one today. Indeed, it is a view I subscribed to and promulgated for years.

As more modern studies with lichens were conducted, however, it became apparent that there was little experimental evidence to support the mutualistic hypothesis. The phycobiont, or algal partner of the lichen symbiosis, supplies the mycobiont, or fungal partner, with sugar alcohols as a source of nutrients, but what, if anything, the mycobiont supplies the phycobiont is not clear. Do compounds pass from fungus to alga? Does the fungus protect the alga from excessive light? At present the answer to both questions appears to be no, although that could be a function of the limited techniques used to study lichen physiology. Based on present information, the mutualistic idea seems to be wrong, and the lichen symbiosis appears to be one-sided. My recent success in synthesizing lichens has convinced me that the fungi parasitize the algae, but that the parasitism is slow and somehow controlled or checked by the algal symbiont. I took about twenty-five years to come to the same conclusion that Schwendener reached 114 years ago, but my findings are based on experimental evidence.

Lichens, left, are growing in the company of a green moss. Both mosses and lichens inhabit a wide range of environments, from the moist tropics to Antarctica, but lichens, unlike mosses, are not single plants.

Jeff Foott

Jerome B. Jacobs

The thallus, or body, of many lichens, below, consists of a protective upper cortex; a photosynthetic algal layer; a medulla, or storage area; and a lower cortex, which participates in the production of rhizines, structures that attach a lichen to its substrate. Many lichen fungi produce fruiting bodies, which release spores. The fungal filaments that grow from these spores will develop into a lichen only if they encounter suitable algae. Soredia, highly magnified above, are algal cells enveloped by filaments. For many lichens, dispersal of soredia is a primary means of propagation.

Jeff Foott

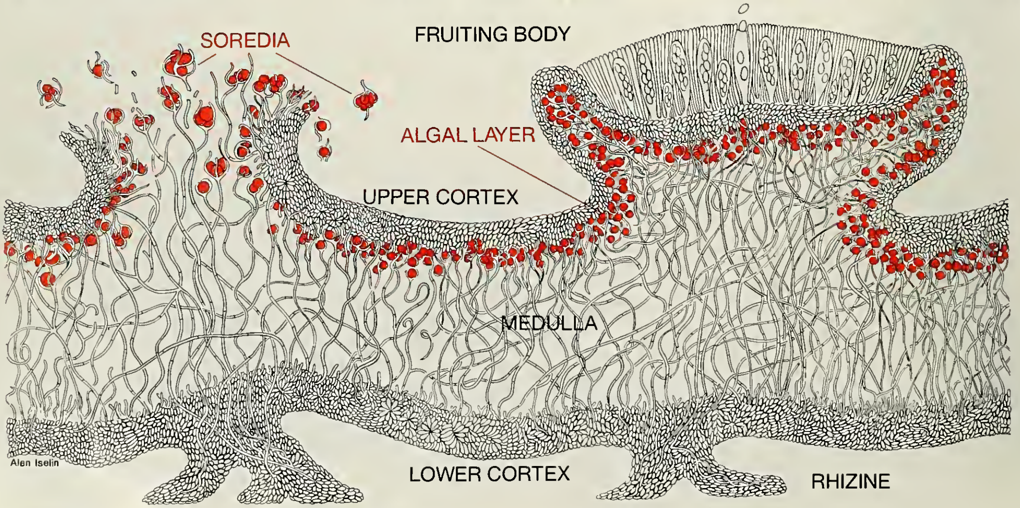
Lichens thrive on a rock face in Yellowstone National Park. In favorable habitats—especially where the air is pure—boulders and rocks may be extensively covered with many species of lichens.

I began synthesis studies in 1956 as part of my Ph.D. program. My early results were not much different from those of other workers: I could obtain the initial stages of lichen synthesis, but the cultures did not develop into mature lichen thalli. The culture conditions I was using for synthesis were obviously not correct. Thus, I undertook a series of trial-and-error studies of various substrates and conditions that might support a complete lichen synthesis.

In 1979 I discovered that thin strips of newly cleaved mica make an ideal substrate and that conditions of high relative humidity stimulate growth of the aerial, thin-walled hyphae necessary to interact with algal cells. Working with scanning electron microscopist Jerome Jacobs, I was able to observe surface interactions between the symbionts during the experiments. We knew that nutrients had to be excluded from the growth medium used in synthesis flasks. In 1939, Swiss botanist E.A. Thomas had almost succeeded in synthesizing lichens on a regular basis. My coworkers and I found that he was not completely successful because he used too rich a medium. When we used a nutrient-rich medium in our synthesis flasks, the symbionts developed thick coatings of mucilage, which impeded the contacts that lead to lichen formation. When nutrients were excluded from the synthesis medium, lichenized unions took place. The technique that resulted from these studies now allows the routine synthesis of many lichens in the laboratory.

In nature, once fungi and algae have come together, the new associations can reproduce in several ways. Many lichens reproduce by thallus fragments or by soredia, specialized propagules that consist of a few algal cells enveloped by fungal hyphae. Easily dispersed from the thallus by wind and rain, soredia develop into mature lichens when they encounter a suitable habitat. Other lichens may develop from free-living algae and fungal hyphae. The ascocarps, or fruiting bodies, often found on a lichen thallus are formed solely by the fungal partner. These structures, which may appear in many forms, such as a sphere or a disk, contain spores that are the result of sexual interactions. Lichen fruits last for several years and discharge numerous spores, which germinate and give rise to fungal hyphae. I suspect that the hyphae of lichen fungi can grow for years in soil or on bark and form lichens when they encounter suitable algae, although I do not know the extent to which these natural syntheses occur. I also feel that free-living populations of algae suitable for lichenization are more common than I previously thought.

In my laboratory studies I tried to answer several questions related to what happens when fungi and algae encounter each other. Can one lichen fungus form unions with different algae? Can one alga serve as symbiont to different



Alan Iselin

Jeff Foott

A common tropical lichen with blood-red pigment, Chiodecton sanguineum *grows as far north as Delaware and as far south as Argentina. This species does not form fruiting bodies, reproducing mainly by fragmentation.*

fungi? Can new, hybrid lichens be created in the laboratory? This mix and match study, made possible by the new synthesis setup, was one I had looked forward to for years.

My first experiments were with *Cladonia cristatella*, my favorite lichen. (According to the Code of Botanical Nomenclature, the name previously given to the lichen is now restricted to the fungal partner. Technically, the symbiosis itself does not have a name, but lichens are still often referred to by the name of the fungus.) *C. cristatella* grows only in the United States and Canada and is common throughout the northeastern and Middle Atlantic states. Known as British soldiers because the bright red fruits of the fungus are reminiscent of the scarlet tunics worn by British soldiers during the American Revolution, this lichen thrives on soil and rotted wood. Its thallus consists of many small (several millimeters wide), bright green lobes, called squamules, crowded together. Each squamule is uplifted at one end and consists of an upper cortex, an algal layer, and a medulla. No lower cortex is present. Soredia are formed during the early development of *C. cristatella*, but mature squamules do not produce them.

The fungal and algal symbionts of this lichen are easily separated and grown in culture. I mixed small portions of the fungus *C. cristatella*, whose normal phycobiont is *Trebouxia erici*, with lichen phycobionts in the same and in different genera and with algae that are not lichenized in nature but that belong to the same algal order (Chlorococcales) as *Trebouxia*. The results were not predictable. The mycobiont formed squamules with five species of *Trebouxia* but not with twelve species of *Pseudotrebouxia*, another common lichen phycobiont, or with nonlichenized species of Chlorococcales. Curiously, with one *Trebouxia* species, it formed soredia but not squamules and it killed three other species of *Trebouxia*. The fungus also formed soredia with a non-Chlorococcales free-living alga from the Negev Desert and with *Pseudotrebouxia usneae*, the phycobiont of *Usnea filipendula*, one of the so-called beard lichens.

In all of these associations the initial interactions were the same: the fungus grew around the algal cells and covered them with a hyphal network. Some algal species, however, were more easily killed by the fungus than others. I discovered that the "compatibility" of lichen partners is relative. Even cells of compatible algal species were killed, but somehow not as quickly as the cells of incompatible species. As a result, a population of algal cells sufficient to sustain the fungal partner could be maintained.

Another lichen that I synthesized successfully was the beard lichen *Usnea strigosa*, whose normal phycobiont is a species of *Pseudotrebouxia*. In the laboratory, the synthetic lichens produced small hairlike fibrils similar to those that make up the thallus of the natural lichen. Here again the algal cells were parasitized by the fungus, but they did not succumb quickly. The fungus started to form synthetic fibrils even with only one or several algal cells. This method of development was different from that of the *Cladonia cristatella* mycobiont, which first formed many soredial groups and then squamules. When mixed with the phycobiont of *C. cristatella*, the mycobiont of *U. strigosa* formed soredia but the algal cells were not sufficiently resistant to this fungus and died before fibrils could form.

My findings, together with Jacobs's scanning electron microscope observations, have shed some light on what makes it possible for a fungus to form a symbiotic relationship with some algae and not with others. Lichens differ from other symbioses in how the partners associate. In some other symbiotic systems the partners recognize each other by means of complementary chemical compounds that bind together. In the rhizobium–legume association, for example, the recognition involves proteins, known as lectins, located on the outer wall of legume cells. These proteins recognize and bind to specific polysaccharides on the walls of symbiotic rhizobia (nitrogen-fixing bacteria). The various lectins help determine if a bacterium will form nodules with the roots of plants such as soybean, clover, and alfalfa.

In contrast, the lichen symbiosis appears to be a controlled parasitism. There is no recognition between symbionts, only degrees of resistance and defense. Parasitism of the alga has slowed to a point where the percentage of cells killed is balanced by production of new cells. The symbionts of *Cladonia cristatella*, for example, are in a natural state of balance. If the mycobiont is exposed to other algae, as in our synthesis flasks, the extent to which it lichenizes them generally depends on how closely the algae are related to the original phycobiont. Thus, the mycobiont accepts *Trebouxia* phycobionts from different *Cladonia* lichens but kills or only partly lichenizes species from other genera of

Robert Carr

Cladonia cristatella *takes different forms in different environments. In this form, the covering of the stalk is particularly leafy, a response to the moist and shady woodland in which it is found.*

Lynn M. Stone

Many lichens are sensitive to pollution. The presence of the leafy, white Hypogymnia physodes *and one of the feathery beard lichens, a species of* Usnea, *indicates that the air around this tree in Canada is clean.*

lichens. The mycobiont does not fully lichenize *Pseudotrebouxia usneae* because the alga cannot survive the fungal parasitism or because its division rate is too slow to replace cells that are killed by the fungus.

The mechanism that controls the balanced relationship between the symbionts, and how it developed, are matters of speculation. We know very little about the evolutionary origins of lichens except what is obvious: they arose from associations of free-living fungi and algae. Most likely, lichens developed from parasitic fungi that preyed on algal cells and that somewhere along the evolutionary line encountered resistant algae. Such a standoff relationship eventually evolved into the lichen.

The situation in lichens may be similar to host–parasite relationships in higher plants. Peter Albersheim and his colleagues at the University of Colorado found that higher plant cells can defend themselves against pathogenic fungi by producing toxic compounds, called phytoalexins, that can stop or slow the growth of the pathogens within the cell. The production of phytoalexins is stimulated by elicitors, molecules located on the cell wall of the pathogen. When a pathogen penetrates a plant cell, receptor sites on the invaginated plasma membrane of the host recognize and activate elicitor molecules on the fungal wall. These molecules, in turn, stimulate the synthesis of phytoalexins by the host. If the elicitor is not recognized by the host cell, phytoalexins are not formed and the pathogen becomes virulent and kills the cell.

We feel that a similar interaction may exist in lichens. For example, in nature the mycobiont *Lecanora dispersa* actually penetrates cells of its phycobiont (*Pseudotrebouxia incrustata*) and forms haustoria, specialized fungal hyphae that develop inside a living algal cell, but in general the algal population of this lichen remains healthy. When the mycobiont was mixed with the phycobiont from another lichen, however, the fungus penetrated the algal cells and then, apparently with nothing to check its growth, literally filled the algal cells with haustoria and intracellular hyphae. All the algal cells were eventually killed. Haustoria, common in many lichens and absent in others, do not appear to absorb nutrients from their host cells. Their role in the symbiosis is not clear.

In 1963, Austrian lichenologist Annemarie Plessl reported that lichens without well-developed thalli have algal cells with one to several deeply situated haustoria. In contrast, lichens with well-organized thalli have algae with haustoria that do not extend far beyond the cell wall. In some highly developed lichens, haustoria are absent altogether.

Plessl's observations support our hypothesis that lichen fungi are parasitic and that the algal hosts are in different stages of resistance. If the evolution of lichens has led to a more complex thallus organization, then we can assume that more advanced lichens have small haustoria or none at all because the algae developed a greater resistance to the fungal parasite, perhaps through a higher production of phytoalexins that limit the growth of the fungus or through a more resistant cell wall. In advanced lichens, haustoria occur only in dead or senescent cells. Young algal cells may have better defensive mechanisms, such as phytoalexins or other compounds that inhibit intrusions by the fungus. Older algal cells may lose their defensive abilities and become more susceptible to fungal attack.

Algal cells in the synthetic squamules were extensively penetrated by haustoria, in contrast to the short, peglike haustoria found in the natural forms. Whatever defensive mechanisms are used by the phycobiont against the mycobiont to restrict haustorial growth in the cell may not be fully developed in the synthesized algal cells.

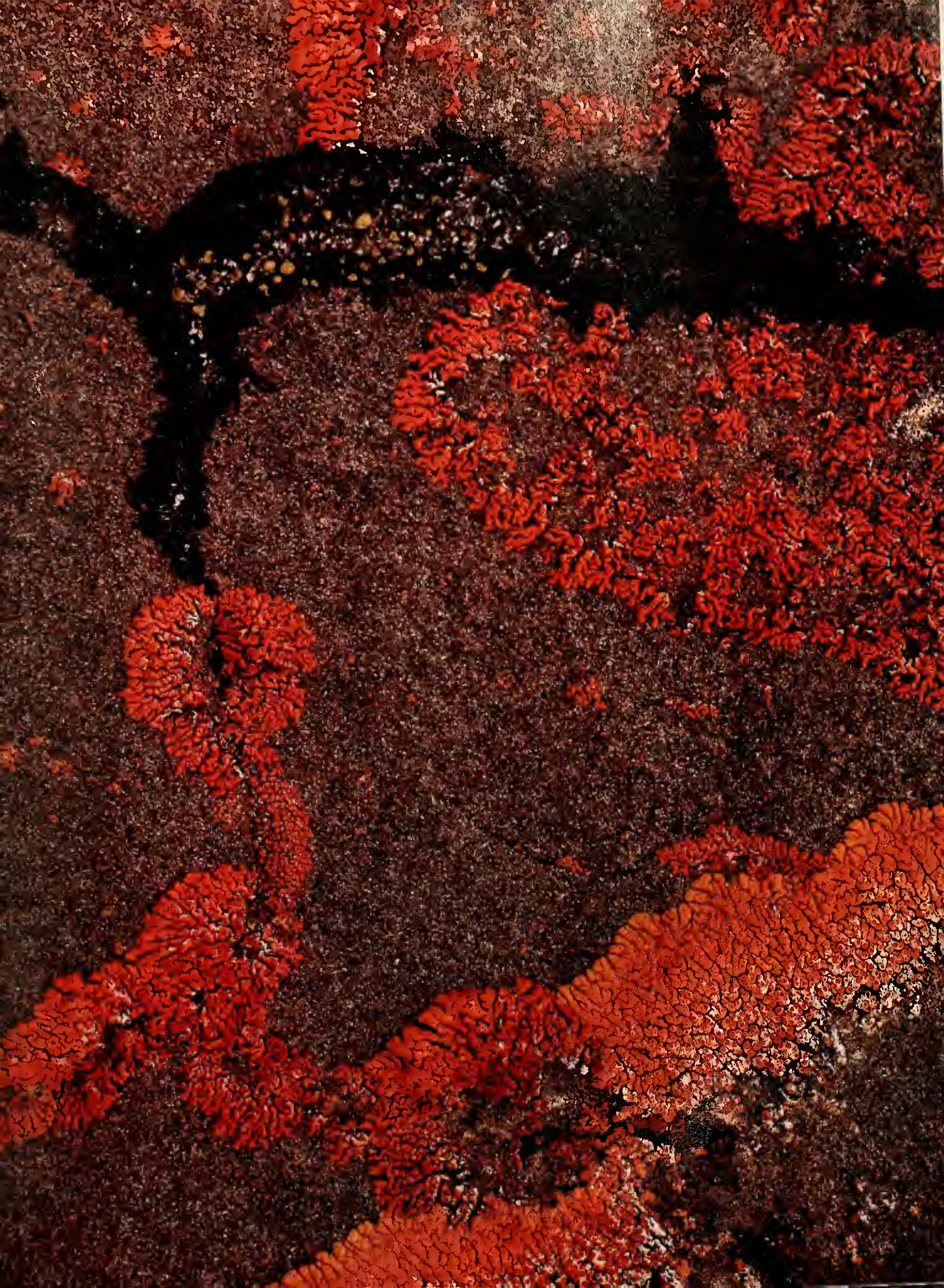
The effect of the parasitic lichen fungus on the algal cells may involve more than physical penetration. For example, a phycobiont will excrete only small amounts of compounds when it is in separate culture, but in the lichen, up to 90 percent of the carbon fixed in photosynthesis by the alga is released as a sugar alcohol and made available to the fungus. What influences this massive excretion of compounds is not known, but it stops almost completely soon after the algae are isolated into culture. Once removed from the influence of the mycobiont, the phycobiont assumes the characteristics of free-living algae.

The idea that the symbiosis in lichens is one of controlled parasitism is not new. The Russian lichenologist Alexander Elenkin proposed such an association in 1902, and later workers ventured similar thoughts. Until now, however, the evidence to support the idea was mostly circumstantial. Our laboratory studies show the parasitic nature of lichen fungi and strongly suggest that in nature such parasitism has been modified by resistant algae.

The controversy over the dual nature of lichens was a prominent one in the late nineteenth century. It was finally resolved but only after a long period of discussion and experimentation. Perhaps our studies will rekindle the related controversy over whether lichens are mutualistic or parasitic. A close look at lichens reveals that their true nature is less idyllic than we presumed, but I suppose that might be said about most biological associations. ☐

Lichens may live for hundreds of years, often on surfaces forbidden to most plants. Rootlike holdfasts penetrate a few millimeters into solid rock, and where cracks occur, the lichen's hold is even firmer.

Jeff Foott



The Lost and Lonely Birds of Mauritius

Vanished are the dodo and eight other species of native birds. Only a handful of Mauritian kestrels remain, and the echo parakeet is down to five survivors

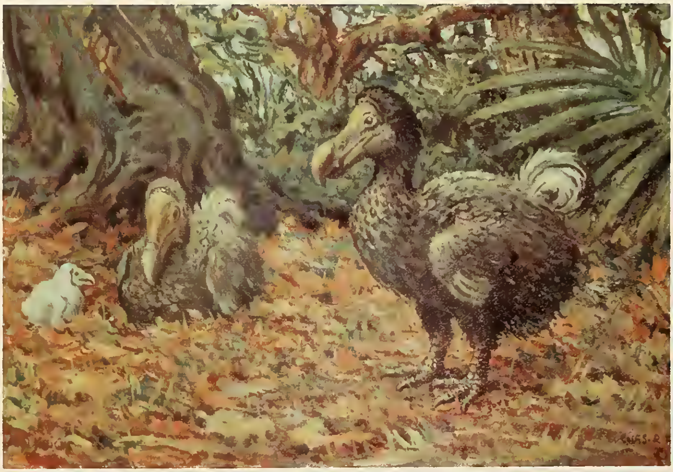
by Roger Pasquier and Carl Jones

Among the tricentennials that will receive little attention is the passing of the last dodo, the overstuffed, flightless, pigeonlike bird that has become the symbol of extinction and hopeless causes. Once plentiful on the island of Mauritius, 550 miles east of Madagascar in the Indian Ocean, the dodo was hunted for food by Portuguese and Dutch sailors who used Mauritius as a provisioning place on voyages to and from the East Indies. The last dodo is believed to have died sometime during the 1680s. The exact reasons for the bird's extinction are not known, but besides human persecution of the adults, dodo eggs were probably eaten by rats, pigs, dogs, and monkeys introduced to the island by sailors.

Extinction is a theme that has been inextricably intertwined with the natural history of Mauritius ever since the dodo. What has happened to the birds there in the last three hundred years illustrates in microcosm the problems now faced by wildlife in many parts of the world. Today the government of Mauritius and several international conservation organizations are working to save what remains of Mauritius's unique birdlife.

Mauritius is small, only 720 square miles, and of volcanic origin. Like the Hawaiian and Galápagos islands, it has never been attached to any continent, and all its plant and animal life reached it by flying or drifting over the ocean. The flora and fauna of Mauritius represent a mixture of African and Asian origins. The half million years since volcanic activity ended have given the island's plants and animals ample time to evolve into forms differing from their mainland ancestors. The dodo, for example, was probably descended from pigeons that flew or were blown to Mauritius. Nearly all the native birds, as well as the island's bats (the only native mammals), insects, reptiles, and plants are now considered distinct species. One feature shared by both the native plants and animals is an adaptation to the cyclones that strike Mauritius every few years. The island's trees have extremely dense wood, a result of very slow growth. A Mauritian tree a thousand years old is not necessarily aged, and individual leaves are known to live two years. These characteristics, along with a thick, interlocking canopy, made the original forest more resistant to strong winds. Even the birds are somehow resistant to cyclones; studies after recent storms have shown far greater mortality among the many introduced species than the native ones.

It was, of course, the long isolation and resultant high degree of specialization that made the dodo and the other birds of Mauritius so vulnerable when new competitors and predators arrived on the island. Humans first landed on Mauritius in 1507, introducing, deliberately or by accident, a host of successful



Destruction of forest habitat and egg predation by macaques have been largely responsible for the decline of the Mauritian kestrel, left. The dodo, right, became extinct about 300 years ago.

Stanley A. Temple

Charles Knight

Sugar cane is now the major source of revenue on Mauritius. Plantations cover roughly 80 percent of the arable land, most of which was originally native forest. Few birds can find food in the cane fields.

R. Zenetta; Bruce Coleman, Inc.

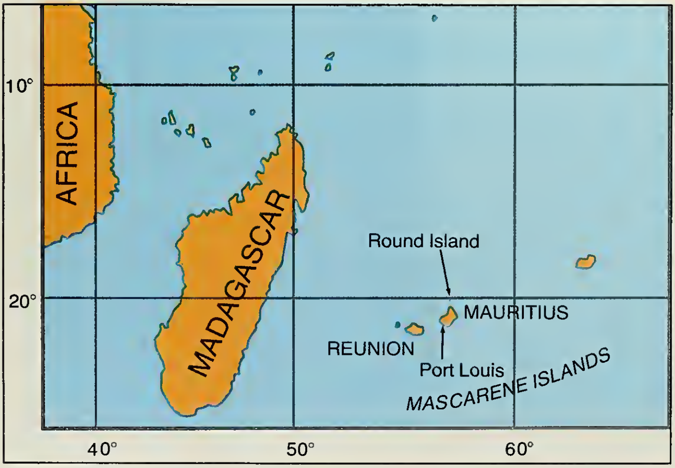
plant and animal colonizers that have thrived at the expense of native species. Aside from the large tracts given over to the cultivation of sugar cane, eucalyptus, tea, and pine, remaining wooded areas are rapidly being invaded by exotic guava, privet, raspberrylike brambles, and vines that prevent native plants from regenerating. The exotics are spread by some of the introduced birds that thrive on their berries, while the native herbaceous plants and shrubs are browsed by nonnative deer and uprooted by pigs. Javan crab-eating macaques (a large, omnivorous monkey present on Mauritius since at least the sixteenth century) eat the fruit of native trees before it ripens and has a chance to germinate.

As the rain forest is fragmented, it loses its resistance to cyclones. Today most of the lowland ebony forests and the palm savannas that once fringed the coast of Mauritius are gone. Only one percent of the native forest remains, some of it in acre-sized patches that are fenced and carefully weeded of alien species several times a year by the Mauritius Forestry Service.

Besides the dodo, other vanished birds of Mauritius include a duck; a goose; a heron; a rail; a coot; an owl; a beautiful blue, white, and red pigeon that is thought to have become extinct 150 years ago; and a large, black, almost flightless ground parrot that was found in the palm savanna. Some of the birds are known from bones or specimens, others only from the accounts of early voyagers. Today, eleven native species of birds are left, eight of them endangered, while seventeen introduced species are common, particularly in settled areas of the island.

For more than a hundred years scientists have noted the decline of the native Mauritian birds, but international attention was not really focused on what was happening until 1972, when it was discovered that the Mauritian kestrel, a small falcon, had been reduced to a population of seven birds. At that time, this kestrel was the rarest bird in the world, and conservationists agreed that something had to be done for it. Stanley Temple, a falcon specialist sent to the island by the International Council for Bird Preservation (ICBP) to study the remaining birds and determine whether they could be helped, found that, in addition to the kestrel, two other birds, the echo parakeet and the pink pigeon, were declining precipitously and required study and conservation action. All were found in the southwest part of the island within a tract of forested ravines known as the Black River Gorges. Since 1972, ICBP, supported by the World Wildlife Fund and the New York Zoological Society, has been working with the Mauritius Forestry Service to save these birds. The varying results illustrate the complexity of the problems faced when one tries to affect a process more than three hundred years in the making. The lessons to be learned have application far beyond Mauritius.

The Mauritian kestrel is slightly larger than a North American kestrel. Unlike most kestrels, which inhabit open country and have long, pointed wings, this one is a forest dweller. It has evolved short, rounded wings and a long tail most useful for maneuverability and rapid chases in dense forest. In this regard, the bird resembles an accipiter, or true hawk, more than a falcon. Its food is dragonflies and other insects, small birds, and geckos that live on branches underneath the forest canopy. The kestrel pursues its prey from a perch by soaring and stooping or by chasing flying insects it spots while on the wing. The major causes for the species' long-term decline have been the diminution of forest habitat and the



Joe Le Monnier

Les Short

Red-whiskered bulbuls were introduced to Mauritius and have flourished. Because they feed on and thereby disperse the seeds of exotic plants, bulbuls compete indirectly with native birds.

alteration of what little forest remains by alien flora that suppress or grow faster than the native plants. This has resulted in a reduction of the kestrel's prey species, which have not adapted to the new vegetation.

Several other factors may also be involved in the kestrel's decline. The birds nest in tree cavities or on cliff faces that may be accessible to macaques, which take the eggs or young birds. Pesticides have probably had an effect, as they have in the decline of so many other birds of prey, by reducing fertility and diminishing the amount of food available; the bodies and eggs of Mauritian kestrels have shown significant amounts of DDT contamination. Direct persecution by humans may also have played a role—the tameness of the kestrels makes them easy targets, and as implied by their local name, *mangeur de poules*, or "chicken eater," they are erroneously believed to prey on chickens. Finally, disease and hereditary weaknesses, to which small populations are particularly vulnerable, may have been a problem for some time without having been detected.

In early 1973 the total population was eight or nine kestrels, and by the end of the year, as a result of captures for captive breeding and the believed shooting of a pair, the wild population was only four or five birds. In subsequent years the wild birds made a remarkable recovery—by 1977 the number had risen to about fifteen. Unfortunately, the population has shown no signs of further growth since then. The encouraging increase may have been just a short-term fluctuation in a population that is slowly approaching extinction.

In late 1973 the decision was made to attempt captive breeding of the birds; ideally, any offspring could be returned to the wild. In other places, captive breeding of birds of prey, particularly falcons, had proved a very useful means of augmenting wild populations—the peregrine falcon represents the most outstanding success of this technique. On Mauritius, aviaries were built in the driest region, presumed to be the most free of avian diseases, and in December 1973 the first pair of captured kestrels was installed. Unfortunately, the female died eleven weeks later; a post-mortem examination revealed a chronic infection of the oviduct. A replacement female was captured the following May, and in September, the normal breeding season, she laid three eggs. One of these hatched, but the chick died when thirteen days old. Over the next two years, none of the eggs that were laid hatched, so in late 1977 three young birds were taken from the wild, two from a nest vulnerable to macaque predation. Shortly thereafter, the female caught in 1974 died from a tumor of the oviduct, a rare condition in birds, previously described only in chickens. During 1978 one female laid twelve eggs, but all proved to be infertile. She was partly imprinted upon humans and did not know how to respond to the male's overtures; her aggressive reaction left him too frightened to copulate with her.

In late 1978 the captive breeding project achieved success when one of the new pairs raised a chick to fledging. All seemed to be going well, but in the next several months each of the kestrels in captivity succumbed to ailments, ranging from respiratory infection to egg peritonitis to pneumonia. Post-mortems performed by the Royal College of Surgeons in London concluded that none of the deaths were attributable to poor management. It is likely that inbreeding and a reduced immunity to alien pathogens, a characteristic of island faunas, had increased the birds' vulnerability to disease.

Meanwhile, the kestrel population in the wild has remained stable at fifteen individuals, albeit with some turnover and a few birds removed for captive breeding. That the population has not continued to grow raises difficult questions about whether the kestrels have saturated their suitable habitat and so can never sustain a larger population. There are currently plans to bring more kestrels into captivity if an appropriate situation, such as discovery of a vulnerable nest, arises. All the project's advisers continue to believe captive breeding could be successful.

In 1973, when there were only seven kestrels on Mauritius, the same forests may have contained as many as sixty echo parakeets. At the time, the kestrel seemed like the higher priority, but today there are only five known parakeets. As with the kestrels, it would appear that the several thousand acres of forest in the Black River Gorges could support more than five birds. The parakeets are, however, very specialized feeders and have never learned to take the fruit and foliage from nonnative trees, even though the closely related rose-ringed parakeet, introduced and now widespread in the less wild areas of Mauritius, does very well on them. In former times, the echo parakeets moved back and forth between the tall forest and an extensive stunted scrubland area that in the mid-1970s was converted to pine plantations. It may be that the scrubland provided the critical balance of food, and the parakeets have not found any replacement. Like the kestrels, the parakeets nest in tree cavities where they are subject to macaque predation, and as the native forest dies off they must increasingly compete with the rose-ringed parakeet and introduced mynahs for nest holes. Forty-one macaque-proof nest boxes have been put up in the forest, but none have been occupied by echo parakeets; some have been taken over by bees, mynahs, and black rats. The last-known successful nesting was in 1975. There were unsuccessful attempts in 1978, 1980, and 1981.

Today, with only two females and three males surviving, there is little hope that a viable population could be regenerated either in the wild or in captivity. Clearly, the lesson to be drawn from the case of the echo parakeet is not to wait until there are so few before doing anything. (In 1876 some visiting ornithologists wrote of the species: "Its numbers are gradually falling . . . frequents the forest only, retiring before cultivation.") Since the rose-ringed parakeet breeds readily in captivity, it is likely that when the echo parakeet was numerous enough to allow for trial pairings of nonrelated birds, it too could have been bred.

It was always clear that one of the major problems of the pink pigeon was nest predation from macaques and rats. Most of the birds nested in one grove of *Cryptomeria* trees, increasing their vulnerability to hungry bands of macaques. In 1976, when the first pigeons were taken into captivity, there were approximately forty in the wild. Nest predators and cyclones—to which all Mauritian birds are increasingly vulnerable as the forest becomes more fragmented—have continued to take their toll. Today the greatest number of pigeons seen at one time in the *Cryptomeria* grove is ten. The birds have prospered in captivity, however; there are currently thirty-five pink pigeons in aviaries on Mauritius and another dozen at the Jersey Wildlife Preservation Trust in the Channel Islands. Birds are exchanged regularly between the two colonies to minimize inbreeding. The forestry service is anxious to establish another off-island colony to further reduce the risk of losing a substantial portion to some unexpected catastrophe such as disease, and so several pairs will soon travel to the New York Zoological Society's Bronx Zoo.

Raising the pigeons is not easy. Several trial matings are usually required before a compatible couple is formed, and because all the captive birds are descended from a small founding population, their offspring show a higher rate of genetically induced defects than a larger population would. Moreover, pink pigeons are sloppy parents, often knocking their one or two eggs out of the flimsy nest or neglecting to feed their chicks. The birds must be helped every step of the way, with artificial nest platforms and foster parents—barbary doves—to rear the young.

Enough pink pigeons have now been bred in captivity to allow for a release on Mauritius, but there seems to be no point in returning birds to the forest from which they are disappearing, and there is no other area of similar wild habitat. The best alternative would be to introduce the pigeons into the Royal Botanical Gardens in the northern part of the island. There they could be kept in a large cage with outside access, fed, and monitored. An adjacent locked cage of pink pigeons would help to create site loyalty. The advantages of the botanical gardens are that no macaques are present on the grounds, there are nonpublic areas where the cages could be set up, and there is a large staff to care for the birds. In addition, the gardens cover more than sixty acres and have a wide variety of mature native trees in which the birds could feed and nest. Overall, this is a safer location than the Black River Gorges and one in which the birds can be studied easily.

Putting the descendants of wild birds

Nest predation by rats and macaques has nearly wiped out the pink pigeon, below. Fewer than fifty birds remain, but captive breeding efforts on Mauritius and at the Jersey Wildlife Preservation Trust may save the species. The plight of the echo parakeet, right, offers less hope. Only five birds survive.

Stanley A. Temple

Stanley A. Temple

in a botanical garden is a compromise with nature, but the consensus is that it should be tried. Today, less than a decade since the Mauritian kestrel was, at six or seven individuals, the rarest bird in the world, there are several contenders for that spot, and many others whose populations number little more than one hundred. Conservationists are increasingly forced to think in terms of triage, the concept developed by French doctors in World War I when deciding which of the masses of wounded to treat: some will die even with surgery, some will survive without any attention, and some will live only if treated. Surely, of the three rarest birds on Mauritius, the pink pigeon seems the one that would benefit most from further ministrations at this stage.

People who visit Mauritius to see its spectacular scenery and whatever they can of its remaining birdlife often come or go via Nairobi. To leave Mauritius for Nairobi, where one sees more species of birds from the airplane window than are found on all of Mauritius, can be a thought-provoking experience. Why, one wonders, should so much effort and money be put into preserving a few birds on a little island when hundreds of species may be threatened on mainlands by the same problems of habitat destruction, pesticides, and alien competitors? Are the conservationists' priorities all wrong?

Conservationists are, of course, working all over the world, but the appeal of islands such as Mauritius is more than just the dodo's siren song of lost causes. The plants and animals on oceanic islands are worth saving precisely because these "simplified" environments can often better reveal underlying patterns less obvious on the complex mainlands. After all, the concept of evolution was made most vivid to Charles Darwin in the Galápagos and to Alfred Russel Wallace in the Celebes. Historically, the overwhelming majority of animal extinctions have taken place on oceanic islands. Now, however, the pattern is changing. As more and more mainland areas of biological importance are altered or destroyed to produce timber, fuelwood, farmland, or housing, what survives are discrete patches of flora and fauna in what was once an unbroken sea of green. These last refuges are beginning to exhibit the same patterns of extinction that biologists already know from oceanic islands. Thus, it is imperative that we learn all we can about native island flora and fauna to better equip ourselves to prevent other species from following their path. ☐

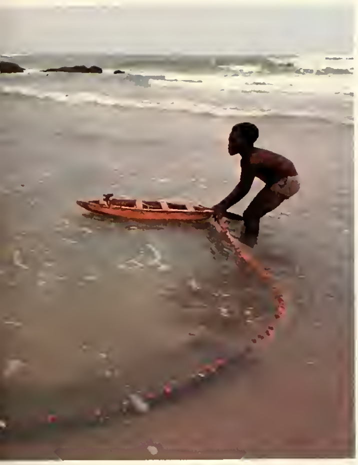
From Child to Fisherman

by Enid Schildkrout

In the gleaming sun of the West African coastline, long, colorful canoes line the beach, ready to venture into the deep Atlantic. These boats are part of a large indigenous fishing industry, which in Ghana is dominated by the Fanti and Ewe peoples. Many boys who grow up in the fishing communities, such as the Fanti of the Cape Coast region shown on these pages, own model boats that they or their fathers have carved. The construction of these boats and the designs that decorate them are almost identical to the large canoes. The outboard motors are only replicated in wood, but the boys actually catch little fish in their nets as they wade in the tide pools along the ocean's edge.

The Fanti commission the real canoes—which are about thirty feet long by six feet wide—from carpenters who live in the inland forest. Each takes up to five months to make, from the initial felling of the tree to the final decoration. The finishing touches are done on the coast, after the canoe has been transported there by truck. As described by Michael Coronel, an art historian who studied Fanti canoe decoration in 1974, the final preparation is done by a herbalist, who

photographs
by Jeffrey Jay Foxx



In southern Ghana, young boys, left, learn the complicated skills of seine fishing by playing with model boats and small nets. While two boys can catch fish by manipulating the small nets, it takes up to eighty men to operate the large nets used in the ocean.

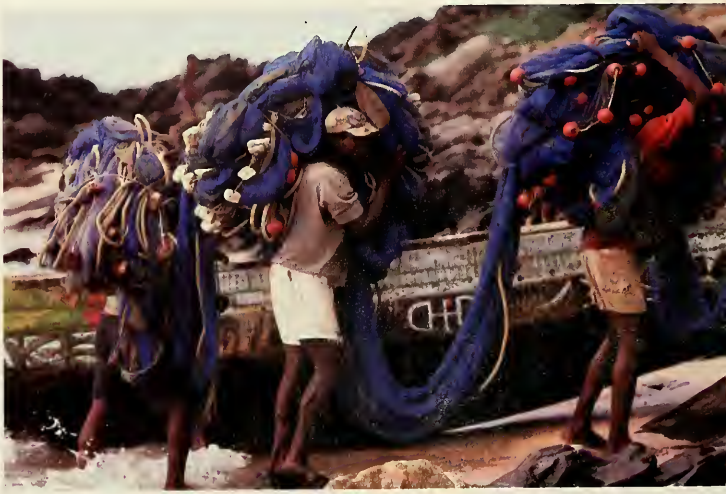
inserts sacred bundles into four holes in the bow as offerings to the sea gods.

The nets used with African canoes vary in size from individual nets—usually used with smaller boats and in lakes, rather than the sea—to large nets up to a half mile in length, which are handled by crews of seventy to eighty men. In one form of seine fishing, one end of the net is held by a group of men on the beach; the crew in the boat casts the net into the sea, returning with the other end farther down the beach; and the net is drawn together by two groups of men on the beach, trapping the catch. Hauling such a net takes at least four or five hours and, as anthropologist Polly Hill writes, "depends on the existence of a crew of well-organized and willing men." West African fishing companies have often been described as "extended families," but in fact most of the time the labor is hired on a seasonal contract basis. The net owner, who is often not a fisherman himself, hires the supervisors and crew members and shares in the profits from the catch. Hill has aptly described the large nets as "knitted capital."

Using old pieces of netting or small, individual nets, the boys at play with their model boats learn about the fishing techniques that they must master, before long, as members of adult fishing expeditions. And as they cooperate in their activity, they emulate as well the social relationships that govern fishing companies, in which different individuals have specialized tasks and responsibilities. They eagerly anticipate the time when they will join the fishermen on their long canoes.

Enid Schildkrout is associate curator in the Department of Anthropology at the American Museum of Natural History.

Below: Fanti men carry a large net, which has been described as "knitted capital." A fishing net, which can be as long as half a mile, is a valuable piece of property that forms the basis of the indigenous West African fishing industry.



Gorilla Society

Avoiding inbreeding is of paramount importance in determining who can belong to the group

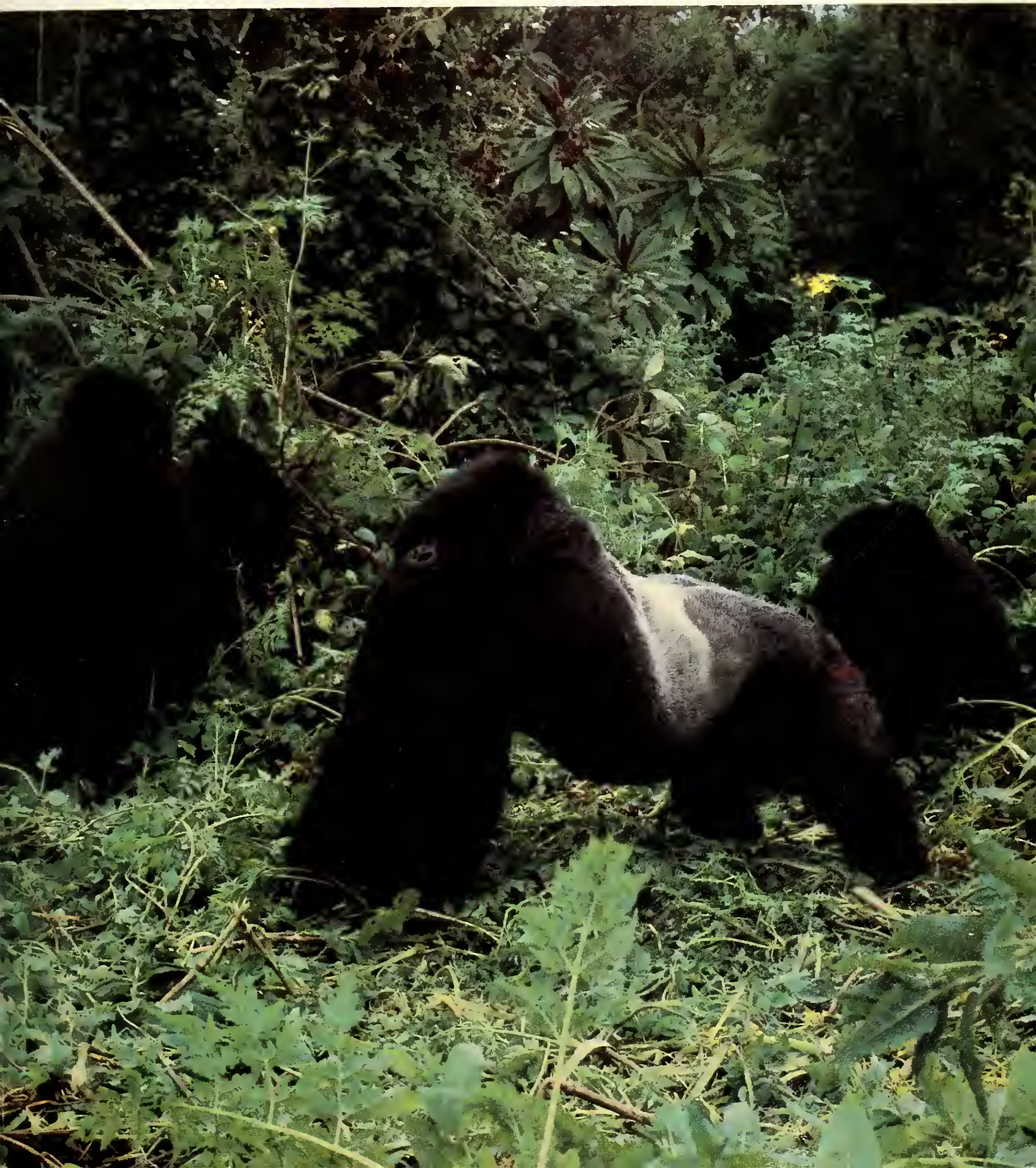
Text and photographs by Peter G. Veit

Eight lofty mountains, known collectively as the Virunga volcanoes, rise in the heart of Africa. Their ecological importance was first recognized in 1925 by Carl Akeley, when at his suggestion, three of them became part of the original Albert National Park. Four years later, the remaining five were added to the park. The area has since been divided and a number of smaller parks established. Today, the two active volcanoes are isolated from the six dormant ones by stretches of farmland. Because of poaching and native farmers encroaching on the area, only the six dormant volcanoes still harbor the rare mountain gorillas, whose future rests in the hands of park conservators from Zaïre, Uganda, and Rwanda.

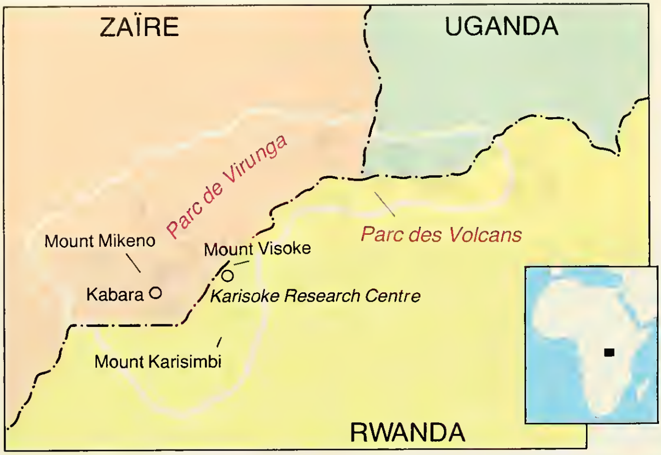
The Virunga volcanoes conservation region is made up of the Parc National de Virunga (Zaïre), the Kigezi Gorilla Sanctuary (Uganda), and the Parc National des Volcans (Rwanda). Within this rather small parkland of 145 square miles, there is an altitudinal range of nearly 7,900 feet, from about 6,900 feet to 14,787 feet at the peak of Mount Karisimbi. The rain forest is dominated by *Hypericum* and *Hagenia* trees but includes a great variety of vegetational zones. Bamboo dominates the lower slopes, herbaceous plants characterize the middle and higher elevations, and subalpine flora crowns the volcano tops. Although the land was originally set aside as a refuge for the mountain gorillas, the montane forest ecosystem is also the home of a large assortment of other animals, many of which are also endangered—golden monkeys, forest elephants, and leopards, to name a few.

Nestled at the southern base of Mount Visoke is the Karisoke Research Centre, sponsored by the National Geographic Society. It is located within the Rwandan Parc National des Volcans, about one-fifth of a mile east of the border with Zaïre. The center is an easy four-hour hike from Kabara, a small meadow at the base of Mount Mikeno, Zaïre, where George B. Schaller carried out his pioneering fieldwork on the behavior and ecology of the mountain go-

Icarus, a dominant silverback in the author's study group, signals by his posture that a rest period is over. Silverbacks attain their silvery white hair after the age of twelve.



Joe Le Monnier



rilla more than twenty years ago. Dian Fossey reopened this station in early 1967, but less than six months later political turmoil forced her to move the short distance across the border to the Karisoke Research Centre.

The center is shrouded by a continuous mist and bombarded by afternoon rains and thunderstorms. Schaller and Fossey chose the Virunga volcanoes conservation region as their study site for good reason, since at above 6,500 feet the solid expanse of vegetation rarely exceeds six feet. Isolated clumps of thick brush do grow on some of the steeper slopes, but for the most part the low vegetation, combined with the uneven topography, is ideal for direct, prolonged daily observations of gorillas.

Three subspecies of gorillas—western lowland, eastern lowland, and mountain gorillas—have been recognized, and they are found in West and east-central Africa, two distinct areas separated by 600 miles of Congo Basin rain forest. The minor differences between the three forms suggest that they diverged relatively recently. Because of human interference and natural barriers, the animals of both regions are scattered into small, often reproductively isolated populations in pockets of remnant forest. The majority of these populations face such severe pressures of encroachment and poaching that they are in danger of being subdivided and even further reduced in size. Although the population dynamics of a few of these small populations are known with some accuracy, total numbers for the western and east-central populations are not.

The western populations are collectively referred to as western lowland gorillas, *Gorilla gorilla gorilla*. They inhabit the tropical rain forests, from sea level to just under 6,500 feet, in the Congo, Gabon, Equatorial Guinea (Rio Muni), Cameroon, the southwest corner of the Central African Republic, and the extreme southeast of Nigeria. This is the subspecies most familiar to the public as almost every zoological garden and circus in the world has a few on

Mount Karisimbi looms out of the mists in this view from the slopes of Mount Visoke. The Karisoke Research Centre is situated at the base of Mount Visoke, in Rwanda's Parc National des Volcans.

exhibit. They are smaller and less robust than their cousins to the east, and their hair is both lighter and shorter. Although common in captivity, very little is known of their behavior and ecology in the wild.

The east-central gorillas are found almost exclusively in the rain forests of Zaïre. Only two small populations reside outside Zaïre—one in the Bwindi Forest Reserve of Uganda; the other in the Virunga volcanoes conservation region. Some of these isolated populations contain fewer than fifty individuals; others may consist of more than five hundred animals. These gorillas are divided into two subspecies: the mountain gorillas, *G. g. beringei*, in the Virunga volcanoes conservation region and the Mount Kahuzi area of Zaïre; and the eastern lowland gorillas, *G. g. graueri*, in the remaining areas of east-central Africa. The eastern lowland gorillas are found in habitats similar to those of the gorillas in West Africa—from sea level to under 8,000 feet—and even less is known about them. The mountain gorillas reside at higher elevations, from approximately 6,500 to 13,500 feet; the greatest altitudes are attained by those in the Virunga volcanoes conservation region. The low temperatures, which at times fall below 32° F, are probably the reason the mountain gorillas are the largest, and have the longest hair, of all gorillas.

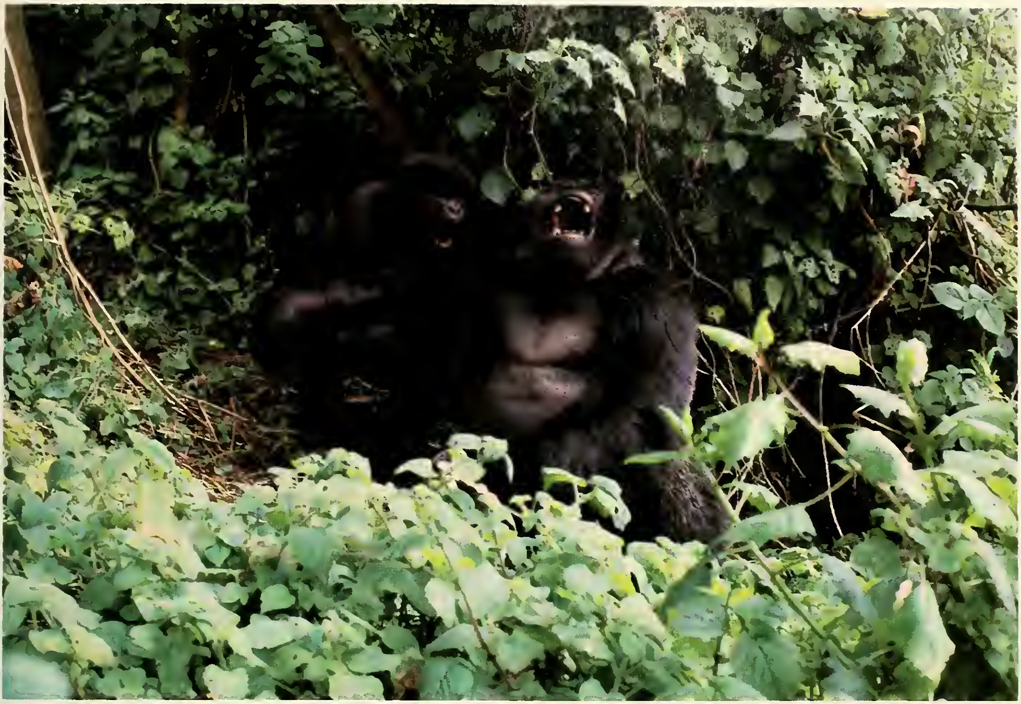
By far the most thoroughly studied of all the gorilla populations is the one on the Virunga volcanoes. Prior to, and following, Schaller's work in 1959–60, numerous short-term projects were carried out on this population. With Fossey's work, and that of her students, these gorillas have been studied and photographed on an almost continual basis since 1955.

With the help of Ramon J. Rhine of the University of California, Riverside, I was given the opportunity to work with gorilla groups near the Karisoke Research Centre. At Fossey's suggestion I began an investigation of the female reproductive cycles: the estrous periods of menstrual cycles, adolescent sterility and pregnancy, the long-term reproductive cycles of offspring, and subsequently, the reasons why individuals transfer out of groups. For two years I followed these gentle animals almost daily as they wandered throughout their domain. The joy of roaming the rain forest and the peace and tranquillity found in sharing life with the gorillas (and the region's many other animals) will remain with me forever.

I was fortunate to have been given the opportunity to work with Group 5, the most stable of the study groups. Although transfers between groups, emigrations, births, and deaths have altered the group's composition over the years, the changes are minor compared with those of the other known groups. Fossey reports that four of the present fourteen members are old-timers from 1967. One of the many advantages of a long-term study is that a detailed genealogy can be established. This information helps in understanding social behavior, which often is influenced and adjusted according to kinship. Of the ten newcomers to Group 5, we are sure of the identity of at least one parent of each one.

Beethoven, an aged silverback, was at least twenty-five years old and the undisputed leader of Group 5 when Fossey first encountered him in 1967. (A silverback is a mature male over twelve years of age, possessing a distinct sagittal crest and an obvious saddle of silvery white hair across his back.) Icarus, approximately seventeen years old in 1980 and the group's only other silverback, is most likely the son of Beethoven. For years he ranked second in command, even though he was larger than his superior. Until the summer of 1980, Group 5

Icarus munches on a shoot of bamboo, a plant that dominates the lower slopes of the Virunga volcanoes conservation region. Gorilla feeding areas are threatened by encroachment from nearby farmers.



A juvenile male enjoys a moment of play with Icarus. Young gorillas are in demand for the pet trade. The silverbacks in a group will defend a youngster from the depredations of poachers, as will its mother.

consisted of these two silverbacks, a juvenile male whose mother had transferred to a neighboring group years earlier, and two aged matriarchs and many of their offspring. These female lineages are often referred to as clans. The two old matriarchs have been the mates of Beethoven for as long as the group has been studied. The group's two other mature females, as well as the one maturing female (all offspring of the patriarch, Beethoven, and one of the two matriarchs), were Icarus' breeding partners. Thus, Group 5 was in essence a coalition of two "subgroups" governed by one overlord, Beethoven. He, his two aged mates, and their dependent offspring formed one subgroup; Icarus, his three females, and their young, the other.

Although Beethoven possessed fewer females than Icarus, he controlled most of the group's activities. Apparently, the number of mates a silverback monopolizes does not in itself determine group leadership. Instead, leadership appears to be linked more with the age and experience of the silverback and the group's confidence in him.

On August 5, 1980, one of Beethoven's old females fell ill. Icarus quickly jumped on her and beat her to a premature death, thereby reducing the number of Beethoven's breeding partners to one. After the old female's death, Icarus began seeking out the aged patriarch and displacing him, a feat he was rarely able to do prior to the fateful incident. Icarus moved from his normal position on the periphery of the group into its midst; to avoid the harassing Icarus, Beethoven quietly took the vacated spot on the outside. Whether this change in dominance is permanent awaits to be seen. Nonetheless, as most of the group members have never known another dominant silverback, they still follow Beethoven's lead. If this change in dominance is permanent, the change of group command will be a slow process, unlike the rapid assumption of new leadership when a group leader dies and the members can no longer follow his guidance.

Beethoven did not intervene while Icarus beat the old female and, indeed, watched the episode from several feet away. As her loss so greatly changed his social standing, why did Beethoven not keep Icarus away from her? Menopause, never before recorded for female gorillas, may have been the reason the old female in Group 5 had not conceived or experienced menstrual cycles for more than three years prior to her death. Quite possibly, she was no longer capable of reproduction, and that may have been a factor in Beethoven's failure to defend her from Icarus' attacks.

Female gorillas begin to breed when they are ten to eleven years old. A healthy adult female undergoes few menstrual cycles; her reproductive biology consists mainly of pregnancy and lactation. Menstrual cycles occur at

From a vantage point on a huge branch of a Hagenia *tree, a blackback male beats his chest in a display of male vigor. He cannot, however, compete for mating privileges with the two older silverbacks in his group.*

Icarus and another silverback, Beethoven, bring up the rear as the study group crosses a large meadow. In the event of danger, subordinate silverbacks make the first move to defend the group.

thirty- to thirty-one-day intervals and the monthly estrous periods last two to three days. Gestation lasts from 250 to 258 days, and one offspring is born every three to five years. Birth intervals may, in part, be dependent on the health and social status of the mother, as well as on the rate of development of her offspring. Males acquire the physique of a silverback at approximately twelve years of age, but usually do not begin breeding until much later, depending on their success at securing females as mates. Young males in captivity have been found to be capable of siring offspring prior to developing into silverbacks but, in the wild, they are not able to compete with the silverbacks for sexual partners. In general, dominance, as implied by the nature and outcome of individual competition, facilitates priority of access to limited resources. In the case of gorillas, dominance also appears to insure access to estrous females.

Although a cycling female may have many suitors in her group, she has only one mate. This male is the highest-ranking silverback in the group not closely related to her. Only he copulates with her until conception. If other group members attempt to compete for the cycling female, her mate keeps constant vigil on her movements and stays near her at all times. At night, he builds his nest close to hers. Possibly as a result of proximity, the male repeatedly mounts and copulates with the female; in such circumstances a female was never observed soliciting sex of her mate or other suitors. At times she even bickered, bit, and swung her arms at the mounted male in her usually futile attempts at ridding herself of his efforts. Such behavior by females whose mates had no competitors, however, was never observed. If there is no chance of the cycling female being inseminated by another male, the mate is not forced to watch her every move; consequently, copulation occurs much less frequently. Indeed, under such conditions, the mate pays little attention to the cycling female and she has to solicit and present to get the necessary copulations from him.

Once impregnated, the female's sexual life depends primarily on the presence of silverbacks in the group that are lower ranking than her mate. If another silverback is available, the female may frequently present to him. Although the solicited silverback usually mounts, he very rarely achieves intromission. This failure is not due to a lack of cooperation on the part of the female. At this time, the female may very well indulge in more sexual behavior (which sometimes includes homosexual mounts) than during the estrous period of her menstrual cycle. Quite often the father of the young that the female is carrying watches from a distance of several feet. Only if the activities get too rough will he intervene, presumably to discourage actions that may harm his offspring within her. If no appropriate silverback is present in the group, the pregnant female indulges in very little sexual behavior and was observed copulating only with her mate. At such times, the mate is an active partner and a successful copulation usually occurs.

All pregnant females are apparently mounted by silverbacks and at least one full copulation takes place (accompanied by a very distinctive series of vocalizations and body postures). This suggests that mounting and copulation after conception may be necessary for a proper pregnancy or delivery.

After giving birth, the new mother goes through two to four years of celibacy. This is a period of lactation, characterized by a great deal of female parental care, including grooming of the infant, carrying it ventrally early and later allowing it to ride dorsally, and

An infant female less than six months old snuggles close to her resting mother. During the next two to four years, the female parent will be celibate and will lavish great care on her offspring.

sleeping with it every night. Her menstrual cycles return after the offspring reaches a point of self-sufficiency, and only then will she copulate again.

After numerous and lengthy discussions with Fossey and her collaborators, and careful study of my data, I am convinced that mounts and copulations between fathers and daughters or between full siblings (as opposed to siblings sharing only one parent, usually the father) rarely occur. A daughter of the group leader becomes the mate of the second ranking silverback, provided he is not her full brother. If this is the case, she moves down the dominance hierarchy of the silverbacks until she encounters one that is not a full sibling. If no appropriate silverback is present in her natal group, she will transfer out to another established group or join a lone silverback. I suspect that, conversely, the female offspring of all lower-ranking silverbacks become mates of the group leader. Mother–son matings probably do not occur either. In all three cases, the two partners would share, on the average, 50 percent of their genes. Matings between more distant relatives, however, readily take place. Maturing males in the group with no suitable females eventually emigrate to lead nomadic lives in search of females with which to start their own groups.

The exchange of daughters between males of the same group and between groups avoids inbreeding and reduces competition for mates, as no silverback will compete with another over females that are either his mother, full sister, or daughter. (This exchange system is probably the primary reason that Beethoven did not force Icarus, his females, and their offspring out of Group 5). The system, when operating among the males of a group, also enables blood relatives to remain in a tightly organized group, which is important for altruistic acts dependent on kinship. The dominant male further benefits from a multi-silverback group because in vocal, visual, and physical interactions with

Beethoven (left) takes a rest break under a tree in the company of a younger blackback male. The latter may eventually emigrate from the group in search of females with which he can form his own group.

other groups or with lone males contesting range or females, it is usually the younger, lower-ranking silverbacks that participate in the strutting and chest-beating displays. The dominant silverback keeps a distance with his family or flees with them. A multisilverback group not only presents a more formidable challenge to intruders of the same species, but its leader risks injury less often by staying clear of the battle zone.

In gorilla societies, then, females transfer out of their natal groups to join established groups or lone silverbacks, whereas males emigrate and lead solitary lives while searching for females with which to start their own groups. This is in contrast to most primate species, in which males routinely transfer into other groups but females rarely leave their natal groups.

Among gorillas, a single male and female do not constitute a separate group; a lone silverback must attract more than one female in order to establish a stable, and therefore viable, breeding unit. The females need not necessarily come from the same group, but the second female must join the silverback shortly after the first or the first female will leave. Apparently, the joining of a single female with a lone male does not create conditions favorable to the successful production of progeny. A single female will, however, remain with a lower-ranking silverback in an established group; there she has the protection and help of other group members, many of them her close relatives. The subgroup of Icarus and his females was formed on this basis. Since all females that transfer into a multisilverback group become the mates of the dominant male, a lower-ranking silverback cannot establish a subgroup by enticing females of other groups to join him.

If no suitable silverback is available for mating, a female mountain gorilla will transfer out of the group in search of an unrelated partner. This has the effect of reducing inbreeding.

Because females can only produce a limited number of offspring in their lives, it benefits them to be very selective of the conditions in which their infants are conceived and born. Males, however, are only limited by the number of females they can inseminate. Obvious male parental investment includes only the maintenance of a home range and the exclusion of foreign males. Thus, females would be expected to transfer willingly as a result of the deleterious effects of close inbreeding, and this appears to be the case. Fossey reports a possible infanticide, followed by cannibalism, of a six-month-old infant by other group members. Interestingly, this offspring was the only known product of a father–daughter mating. Just why the young female did not transfer out is unclear.

While the great majority of changes in group composition, aside from births and deaths, are measures reducing inbreeding in females and lack of mates for males, there are other reasons for transfers. For example, some females apparently transfer to increase their position in the female dominance hierarchy.

Clearly, the social structure of gorilla societies is quite complex and much more organized and rigorous than originally anticipated. Only by continuing to study these great apes in their natural conditions can we hope to understand them and, perhaps, ourselves a little better. What an enormous loss if the gorilla were to be exterminated. ☐

Menacing the Mountain Gorilla

Humans are the only serious threat to the mountain gorillas. Some tribes still hunt them for food, others use slain gorillas in rituals, celebrations, and for witchcraft, as certain parts are reputed to have magical properties. Gorilla poaching for other purposes is a fairly recent development; an affluent market has developed for gorilla skulls, hands, and feet, as well as for live young to serve as pets. To capture a live gorilla, poachers often need to kill a number of group members, usually one or more silverbacks and the mother, all of whom charge in defense of the young.

Poaching pressures on the area's animals are coming largely from the Zaïre side of the Virunga volcanoes conservation region. Few large mammals reside in the Rwandan Parc National des Volcans or the Ugandan Kigezi Gorilla Sanctuary. The primary quarry of the poachers are two species of antelope: the black-fronted duiker and the bushbuck. In the past, villagers hunted exclusively for personal needs; now most of the meat and skins are sold for profit. Wire snares, fastened by one or two bamboo poles, are secured to the ground with small sticks, which act as triggers. Such traps, set on well-used trails, are extremely efficient in capturing animals, but fail to bring rapid death to the suffering creatures.

Snares of this type are not gorilla proof, and the apes often step into them. Although the gorillas are usually strong enough to pull the wire cable from the bamboo poles, they are less capable of freeing themselves of the loop. It acts like a noose, slowly draining the life of the affected appendage until it rots and falls off, and many gorillas have deformed or missing hands and feet as a result of such encounters. Often, the weakened animals die of secondary causes such as pneumonia and gangrene.

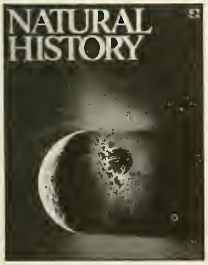
Land encroachment, if continued at its present pace, will in the long run prove even more detrimental to the gorillas than poaching. The threat is most obvious from the Rwandan and the Ugandan sides of the Virunga volcanoes conservation region. The boundary of the Parc National des Volcans runs along the base of five volcanoes but also incorporates many lush saddle areas between them. In recent years, these areas have repeatedly been considered by the Rwandan government for cultivation and cattle grazing. In 1969, 40 percent of the then 77-square-mile national park was allocated for the growth of pyrethrum, a cash crop whose important extract (used in the manufacture of insecticides) is now easily synthesized in the laboratory. Continued cultivation of these gorilla feeding grounds would severely hamper the chances for survival of all the park's animals.

In late 1978 and early 1979, a study group of gorillas was hit repeatedly by poachers and virtually exterminated. In response to the media outcry, the British Fauna and Flora Preservation Society initiated the Mountain Gorilla Project. Together with a number of conservation organizations and volunteer groups, this project is providing the necessary expertise, equipment, and funds to help the Rwandans save the mountain gorilla in their sector of the Virunga volcanoes conservation region. Guards and guides are now being trained both to combat the pressures of poaching and to increase the revenue from tourism.

In 1959, George Schaller estimated the mountain gorilla population in the then 197-square-mile Virunga volcanoes conservation region at 400 to 500 individuals. In just over twenty years, this figure has dropped alarmingly to fewer than 250. Taking an educated guess of the population in the Mount Kahuzi area, there are certainly fewer than 1,000 mountain gorillas alive today.

Again, we're only $15 a year

HISTORY REPEATS ITSELF



NATURAL HISTORY Magazine is published by the American Museum of Natural History, New York, N.Y. Please allow 7 weeks for delivery of first issue. Outside U.S. please add $5 per year for postage.

History repeats itself in the new year by offering you membership in the Museum of Natural History and 12 galvanizing issues of NATURAL HISTORY Magazine at last year's low price of just $15.

☐ YES, send me 12 months of NATURAL HISTORY for just $15 (I save $9 over the newsstand rate) and my museum membership which is included in my subscription.

NAME______________________________
ADDRESS______________________________
CITY________________STATE__________ZIP______

Include a gift membership for:

NAME______________________________
ADDRESS______________________________
CITY________________STATE__________ZIP______

I PREFER TO INCREASE MY SAVINGS AND ENJOYMENT: J539
☐ Send 2 years at $26 ☐ Send 3 years at $35

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

Postage will be paid by addressee

NATURAL HISTORY
P.O. Box 4200
Bergenfield, New Jersey 07621

In the Volcano

The physical hazards and scientific rewards of living in an intermittently active Caribbean volcano

by Haraldur Sigurdsson

Predicting the future behavior of a volcano—a task with obvious rewards—requires not only monitoring changing conditions within the volcano but also tracing its history. Monitoring of volcanoes is carried out by geophysical and geochemical techniques that yield continuous measurements of specific parameters: the frequency of earthquakes, changes of gravity, resistance to electricity, and so on. Knowledge of a volcano's past behavior, needed to construct accurate models of volcanic processes, can be obtained in part from historical records. But the best source of volcanic history is the succession of deposits on the volcano's flanks. And the only way to obtain information of this kind is to live with—and occasionally in—the volcano. To this end I have visited Soufrière, the volcano on Saint Vincent in the Windward Islands, some fifty times during the past decade.

One of five volcanoes in the eastern Caribbean named Soufrière, Saint Vincent's is particularly rewarding to monitor and study because it is frequently active. In fact, this Soufrière has a record of volcanic activity extending back at least half a million years. Judging from the evidence of carbon-14 dating of charcoal in its volcanic deposits, Soufrière's present period of activity started about A.D. 1300. Prior to the fourteenth century, the volcano slumbered through a dormant period of about 2,500 years, following an earlier period of explosive activity. The current period of activity has lasted 700 years, but written records extend back only 263 years from the present.

Saint Vincent's Soufrière erupted in 1718, 1812, 1902, 1971, and 1979. The oldest remaining account of an eruption is one written by Daniel Defoe and published on July 5, 1718, in *Mist's Journal*, an eighteenth-century British periodical. Defoe based his account on the reports of European plantation owners, and in somewhat overwrought language, he explained the explosion "relates to the entire desolation of the island of Saint Vincent . . . in a manner astonishing to all the world, the like of which never happened since the creation, or, at least not since the destruction of the earth by the water in the general deluge." Defoe's description details a major explosive eruption with extensive ashfall on the neighboring islands, but the credibility of his account is tarnished by his insistence that the entire island of Saint Vincent had disappeared as a result of the eruption. The 1718 explosion left a mile-wide, 1,500-foot-deep crater and a crater lake.

The 1812 eruption was accompanied by the emission of large volumes of ash and by ash flows down the volcano's flanks to the east and west. The eruption blasted out a new crater in Soufrière's summit, just to the northwest of the old crater, and killed fifty-six people living in settlements on the volcano's east and west slopes. Both craters appear to have been active during the 1812 episode.

The next violent outburst, in 1902, involved a series of explosions that resulted in the generation of ash flows that rushed down the flanks of the volcano, filling the 1812 crater to the brim with ash and pumice, and killing 1,565 people through asphyxiation and burning. Shortly after the 1902 eruption, the crater lake was reestablished and reached a depth of 600 feet.

My preoccupation with this volcano began in 1971 when some extraordinary developments took place in the 1718 Soufrière crater. In October of 1971 the crater lake inexplicably rose 100 feet above its normal level and the lake water started to boil. That month I entered Soufrière's crater with a group of coworkers for the first time. It was an eerie experience climbing down the crater's steep walls to the level of the hot lake in order to carry out daily temperature measurements of the water. The middle of the lake was found to be 212°F—the temperature of boiling water—while the edges were somewhat cooler. Three weeks after our initial descent, a lava island emerged in the center of the steaming lake, indicating that an underwater eruption had been in progress on the crater floor for some time.

The lava island in the center of the boiling crater lake proved to be an irresistible lure, and soon two of us were rowing across the hot lake in a double-hulled fiberglass boat to recover samples from the newly emerged lava island. We were confident at the time that the ongoing eruption was nonexplosive and that the personal risk was thus minimal. Three months later, the lava extrusion ceased and Soufrière returned to an uneasy period of rest, which was closely monitored by scientists from the Trinidad campus of the University of the West Indies.

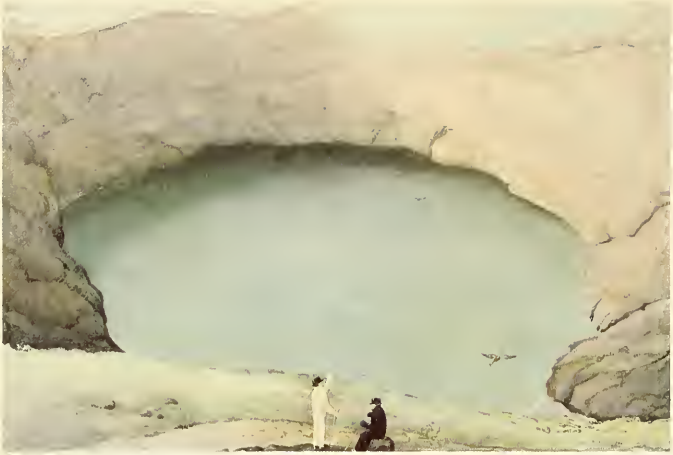
In April 1979, Soufrière exploded once again and with little warning. Thanks to sophisticated monitoring equipment and the efficient evacuation of the volcano area, however, no lives were lost during the violent explosions, which lasted two weeks and blasted the 1971 lava island clear out of the crater. No sooner had the explosive activity died down, when new lava started to flow on the crater floor, gradually building up a domelike mass in the center of the main crater. This extrusion developed peacefully until October 1979, at which time Soufrière became inactive yet again.

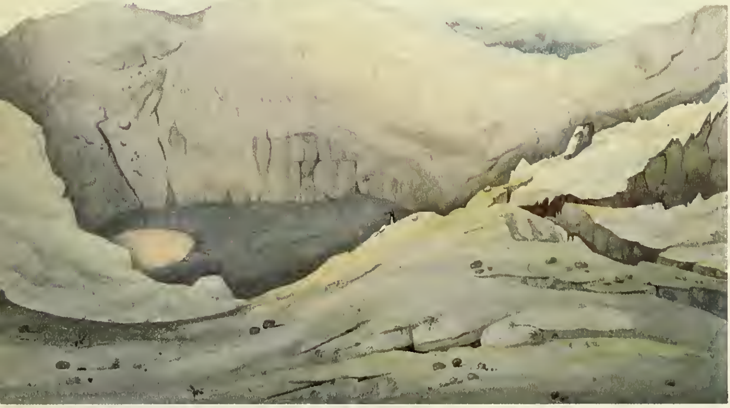
About a month after the 1979 explosive eruption, while the new lava dome was being slowly extruded onto the crater floor, scientists began to venture into the Soufrière crater. But no one wanted to linger there. Those crater trips were characterized by mad dashes down the 500-foot-steep south crater wall and rapid measurements of the increase in the rate and size of lava flow

The mile-wide crater of Soufrière, on the island of Saint Vincent, is shown here before the April 1979 eruption. That event blasted out the lava island in the crater and created a new vent.

Nicholas Devore III; Bruce Coleman, Inc.

courtesy of Sir Colin Tennant





Among the best records of early Soufrière craters are the watercolor paintings of Lansdown Guilding, a nineteenth-century British vicar with an interest in natural history, who lived on the island of Saint Vincent. The top painting, made in 1821, is a view of the mile-wide main Soufrière crater, containing a large lake. The bottom painting, made in 1823, shows the new crater of 1812 formed north of the main crater. This painting is the only existing view of the new crater before it was filled in by ash from the 1902 eruptions.

on the crater floor, followed by mad dashes out of the crater to the relative safety of the crater rim. In the course of these short visits, we discovered that the almost vertical inner walls of the crater, having been sandblasted clean during the explosive eruptions in April 1979, now revealed the stratigraphic layering, and thus the history, of the volcano. By November 1980, the volcano had settled into a period of dormancy and conditions were ideal for a short stay inside the crater to gather scientific information on the prehistoric deposits laid bare by the 1979 eruption.

On this trip to the crater floor I was accompanied by Maxwell Porter, who is employed by the government of Saint Vincent to monitor the volcano. Local porters helped us carry our gear, consisting of a seismograph, surveying equipment, thermometers, shovels, camping equipment, and food, up the slopes of the volcano, but no amount of persuasion could induce them to make the descent into the crater. Earlier we had fixed reliable climbing ropes from the crater rim to the floor 500 feet below, and the descent was a relatively simple matter, but each of us had to make two trips to transport all the equipment.

Living inside the crater, which measures about one mile in diameter and has almost vertical walls 500 to 1,000 feet high, was like being inside a giant gun barrel. The high circular walls provided the only view, and all that we could see of the outside world was the passage, from one side of the crater rim to the other, of the sun and the moon overhead. Being deprived of an exterior view, our attention was directed inward to the features of the crater. The crater floor was a relatively flat plain, covered by steaming yellow- to orange-colored volcanic ash deposited in 1979. A 300-foot-high jumble of black lava blocks rose from the center of the crater floor. Sulfurous fumes emanated from the lava, reminding us that this was Soufrière's most recent discharge. Since we were in a somewhat precarious situation, we were determined not to be caught unawares by any further eruptions.

Our first task was to install the seismograph in its tent and get it operational. We chose a site for the instrument at the edge of the new lava extrusion, hoping to detect the slightest vibration should any motion of magma, or cooling rock, occur in the volcano's conduit under our feet. When you are in a deep hole in the ground, the sun seems to set early, and it was almost dark by the time we had our own tent pitched on a sandy patch of ground in the middle of the flat crater floor. We knew we had picked the windiest spot, but at least we were out of range of rock falls from both the steep lava dome and the vertical, unstable crater walls. An added advantage of our tent site was that the hot volcanic sand underneath it, which had a temperature of about 120°F, kept our sleeping bags constantly warm. This happy circumstance was explained the next day, when we dug into the crater floor. We found that two to three feet below the surface, the groundwater was at boiling point. This was due to heat transfer from the cooling magma, which was gradually crystallizing in the central conduit, or pipe, of the volcano, underneath the lava dome.

A quick inspection of the crater walls, which were either steaming or dry but too hot to touch, showed that the temperature of the wall rock in most areas of the crater was also near the boiling point of water. This finding may explain the absence of a crater lake. With a rainfall of more than 100 inches per year, the crater should have accumulated five million cubic yards of water a year following the 1979 eruption, but instead, there was only one shallow pond to the east of the lava dome, and to the west, another smaller pond, which disappears in dry weather. Evidently, the entire basin is so hot that most rainwater falling into it evaporates. Calculations of heat transfer from the cooling lava indicate that it will take several years of rainfall to exhaust this source of surface heat.

The next three days were busy ones as we set about our main task of surveying the crater and compiling a topographic and geologic map. We were blessed by good weather, except for sudden and unpredictable whirlwinds, which spun around the inside of the crater, whipping up clouds of volcanic ash and sand. Our 6:00 A.M. to 6:00 P.M. routine while making the survey allowed us to get back to our camp on the crater floor, service the seismograph instruments, and have dinner before dark. All our food had to be laboriously carried up Soufrière and down into the crater, so our menu was simple and entirely dictated by weight. The fare consisted mainly of wheat germ, raisins, cheese, granola cereal, and sardines. Our liquid refreshment was water from a slightly warm spring that issued out of a cliff in the southwest corner of the crater.

The seismograph station on the crater floor operated faultlessly twenty-four hours a day. We recorded local earthquakes at the rate of one every five hours, but that was not often enough to cause us concern. The earthquakes were all of local origin and were probably caused by the cooling and contraction of the hot, domelike lava mass on the floor. We were to learn later that our temporary seismograph station was far more sensitive than any of the regular seismographs permanently installed at various sites on and near the volcano. Even the closest permanent seismograph station, about 750 yards from the crater rim, only recorded a fraction of the earthquakes we were able to detect on the crater floor.

By the afternoon of the fourth day, Porter and I had completed our topographic survey of the crater and laid the groundwork for a thorough subsequent

Refugees from a series of violent outbursts in Soufrière in 1902 gathered together for this photograph. The explosions generated ash flows that killed more than 1,500 persons.

AMNH

geologic study of the crater walls and floor. Since by then we were out of food, we had to leave. We made the tedious climb up to the crater rim, where we were met by porters who accompanied us down the exterior slopes of Soufrière to our main research base on a plantation at the eastern foot of the volcano.

Three days later, I was anxious to continue with the geologic study of the crater. Porter was not available, but I decided to carry on alone. This meant leaving behind the seismograph equipment and other heavy items, as I had a full load with my other supplies and tent. By noon of November 22, 1979, I was back on the crater floor, where for the next four days and nights I would be entirely alone. I selected a new campsite sheltered from the sudden whirlwinds but close to the spring of water. My accommodations and diet were Spartan, but the exciting discoveries of the next few days more than made up for the physical inconveniences.

With the aid of the newly made topographic survey, I was able to map out the geologic features of the crater area exposed when the 1979 explosive eruption ripped all cover off the volcano, revealing its bare bones. I found that the upper part of Soufrière consisted of four major formations, which told a few thousand years of the history of this volcano. The youngest of these formations is composed of a series of ash-flow deposits, which are characteristic of the volcanic activity of Soufrière during the historical period from 1718 to the present. Underneath them is a thick layer of lava flows that represent the infilling of a large crater. Under that layer, in turn, is a formation of volcanic ash deposits that resulted from explosive activity. The oldest of the formations is composed of a series of debris flows, or rock avalanches, formed by the collapse of the summit of the volcano 4,000 years ago. The debris flows occur only in the southern half of the crater wall, where they are up to 325 feet thick, and extend to the south flank of the volcano. Their discovery made all my troubles seem worthwhile.

I knew that in its early history, Soufrière was considerably higher than it is at present. The volcano's southern sector had been inexplicably destroyed and what remains today is the northern half of the Soufrière that existed 4,000 years ago, a high, rocky amphitheater encircling the 1718 and 1812 craters. Scientists refer to such amphitheater-like crater remnants as sommas, after the well-known somma of Vesuvius.

Only six months before my solitary stay in the Soufrière crater, a new somma had been formed on Mount St. Helens in Washington State, when that mountain blasted out its northern sector, creating a vast horseshoe-shaped amphitheater. I had worked at Mount St. Helens in the summer of 1980 and knew that the somma there resembled the

In 1971, a lava eruption began under the water of the Soufrière crater lake. The lake got so hot it began to boil. After a few weeks of volcanic activity, a lava island emerged from the steaming water.

Haraldur Sigurdsson

somma and debris flows at Soufrière. I tried not to be overly influenced by Mount St. Helens, but all the accumulating evidence at Soufrière seemed to indicate that the massive debris flows exposed in the south wall of the crater were best accounted for by the destruction of the south flank of the old Soufrière volcanic cone. Thus two major eruptions—that of Soufrière 4,000 years ago and that of Mount St. Helens in 1980—had caused a similar destruction of a large sector of the flanks of those volcanoes and resulted in somma formation and the generation of debris flows.

An event took place at half past seven on my first evening alone in the crater that made me regret having left the seismograph behind. That night and again at noon on the following day, I felt and heard distinct earthquakes. (Later examination of the records from seismograph stations outside the crater showed that these earthquakes were local events that originated in or underneath the crater.) Because of the quakes, I grew more tense during the next three days and sleepless nights. I was therefore relieved when I reached the crater rim

The Bird Bottle
A center-hall colonial residence for your fine-feathered friends.

This unusual birdhouse is a faithful reproduction of the original, excavated from the garden of the 1760 James Geddy house in Colonial Williamsburg.

It measures 8¾" long, and is hand-turned in clay on a potter's wheel, then fired to a rich terra-cotta glaze. Hang it under the eaves of your home or from a tree, and add a twig for a perch.

It not only adds an authentic colonial touch, but will give delightful hours of enjoyment watching your fine-feathered neighbors in their new home.

You may order yours at $13.50 (postage and handling included) directly from Colonial Williamsburg, and receive our current colorful brochure, by calling toll free 1 800 446-9240, Dept. 160 at any time and charging your MasterCard, Visa, American Express Card. In AK, HI, and VA, call 1 804 229-1000 Ext. 5493, Dept. 160 Mon-Sat from 9 to 5 EST. VA residents add 4% sales tax. Or write:

COLONIAL Williamsburg
Box CH, Dept. 160
Williamsburg, VA 23187

Halls

YOURS FREE!

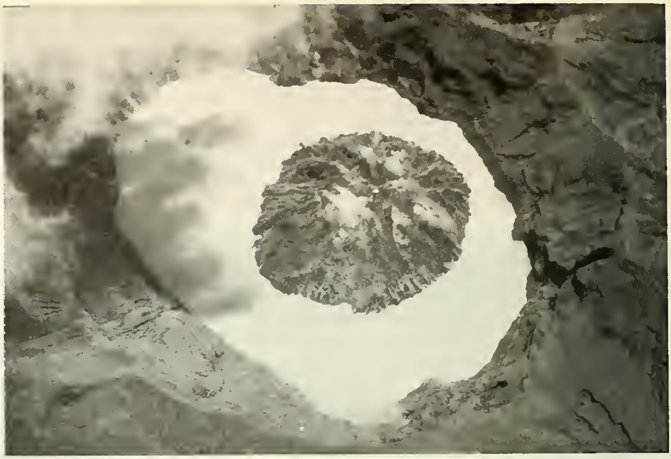
...WITH YOUR FIRST ORDER FROM HALLS CATALOG.

This gleaming bookmarker (gold electro plate over brass) is yours, FREE, with your first purchase from the Halls Catalog filled with famous fashions, gifts and ideas for your home. Dozens of Halls exclusives found in no other catalogs!
Complete and return for a free catalog.

Name
Address
City
State Zip

Halls Catalog
Dept. 1710
505 Armour Road
North Kansas City, MO 64116

Haraldur Sigurdsson



The water level in the crater lake had risen about 100 feet even before the lava island emerged and the water temperature had reached the boiling point.

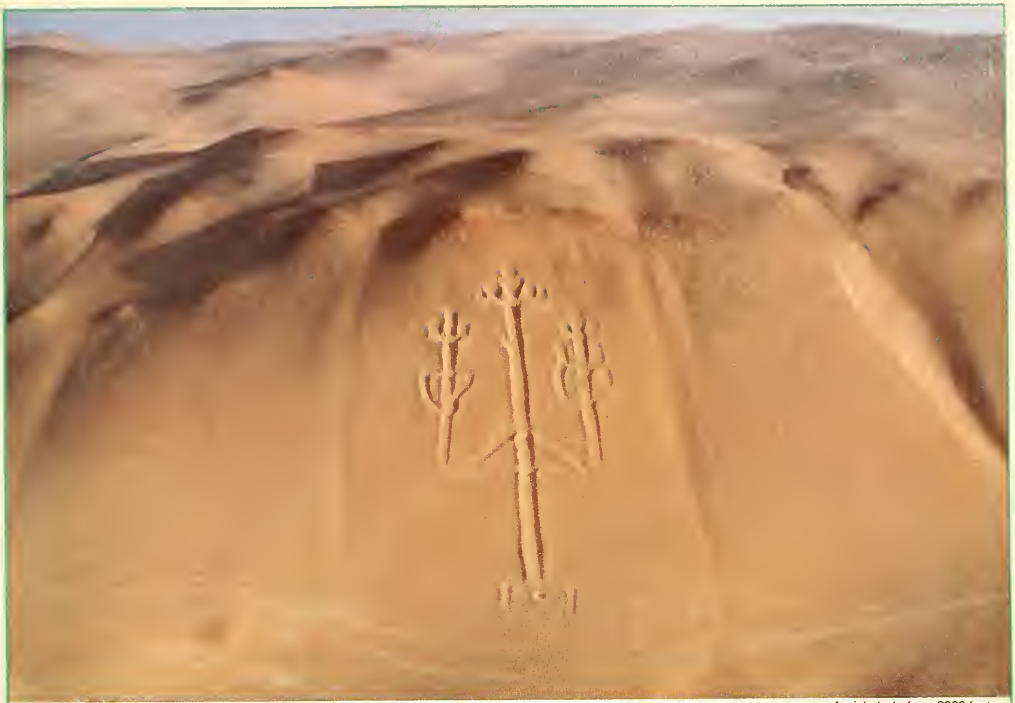
In November 1980, following the eruptions of 1979, Soufrière entered a period of dormancy. That time was chosen for the start of a crater survey, which required a steep descent by ropes.

on the fourth day, after having completed the reconnaissance geologic survey of the crater.

Several years of fieldwork will be required before Soufrière's complete volcanic history can be pieced together. Meantime the volcano remains a constant threat to the population of Saint Vincent. And the economic impact of volcanic activity—for example, the cost of evacuating 15,000 people from the danger zone during the 1979 eruption—puts a severe strain on the resources of the island's government.

Monitoring of the volcano has been stepped up significantly by scientists from the University of the West Indies, who are now constructing a volcano observatory on Saint Vincent, with financial aid from the United Nations. But the monitoring of Soufrière presents a

Haraldur Sigurdsson



Aerial photo from 2000 feet

The country of incredibilities.

How do you explain drawings cut into the ground, so vast, they become intelligible only when viewed from 1000 feet above. You don't. You accept them at face value. The romantics among us pretend the Wright Brothers existed in another life. The rest of us see them as another of Peru's staggering incredibilities, like the walls of stone that fit so meticulously together there's no room for a finger nail between. And then stand defying the centuries without the aid of a grain of mortar.

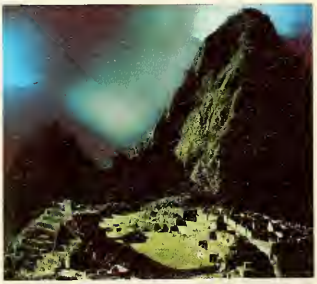
Or, Machu Picchu, the city lost for 400 years in an impenetrable tangle of vines and leaves, yet so astonishingly preserved their homes could be occupied today but for their lack of the original thatched roofing.

Or, like the complex of roads originating there and reaching into the deep fastnesses of the Inca's vast empire, larger even than Ancient Rome's. Or like mountains so high, the clouds can't catch up to them.

Or like the colorful attire of its people, so imaginative, so expressive of a nation's indomitable spirit. Or like Peru's folk art and jewelry, continuing a tradition that began thousands of years ago. Or the fragile bridges, so similar to spans of lace, that you wonder how they carried man's weight safely from mountain to mountain. What secret of engineering do they hold?

Come to Peru. Discover the brink of civilization in our jungles and witness its advance over the centuries in Lima, our sophisticated capital.

Here is a country out of sight but not out of reach. Find out from your travel agent, or send for fascinating literature that tells you what to see and what to know about Peru.



Peruvian Tourism Promotion Fund
1450 Coral Way, Suite 2
Miami, Florida 33145 NH/3/82

NAME
ADDRESS
CITY STATE ZIP

Peru
the country of incredibilities

The Wilderness Travel
World of Discovery

Wildlife & Natural History Tours
Anthropology & Archaeology Tours
Trekking Expeditions
Jungle Exploration

• CHINA •
• Kenya • Tanzania • Galapagos •
• Peru • Ecuador • The Amazon •
• Nepal • Australia •
• Alaska • New Guinea •

Write for our NEW 32-page
fully illustrated 1982 catalog

Name
Address
Zip

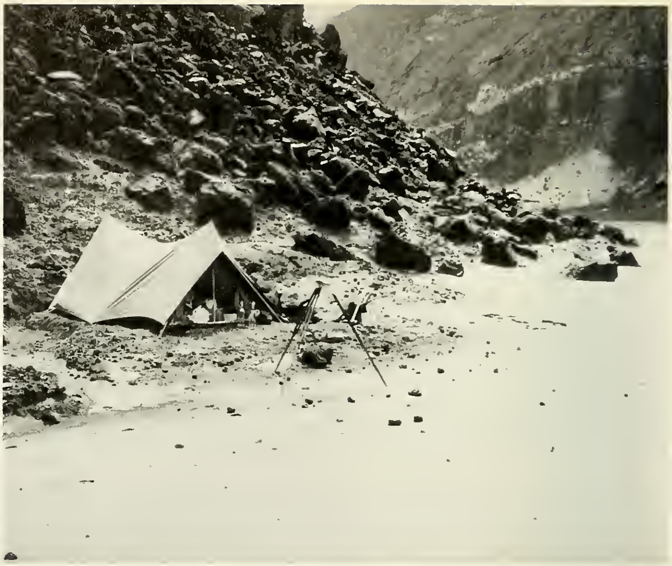
WILDERNESS TRAVEL
1760-N Solano Avenue, Berkeley, California 94707
(415) 524-5111

Enjoy the romance...
Send for a luxurious color catalogue of beautiful lingerie. French bra and bikini sets, lacy teddies, gowns, kimonos & much more.

Victoria's Secret
designer lingerie

Send $3 to Victoria's Secret, Dept. NH-03
Box 31442, San Francisco, CA 94131
Boutiques: San Francisco, Palo Alto & Cupertino

Haraldur Sigurdsson



A temporary campsite was set up in the fall of 1980 at the edge of the new lava. There was then no water on the crater floor and the crater wall behind the tent was too hot to touch.

major problem because this volcano gives very few recognizable signals before erupting, and even the most sophisticated geophysical instrumentation available does not provide a reliable warning of an eruption. Seismograph stations on the volcano's flanks have so far proved the most useful, and in 1979 scientists at the University of the West Indies alerted the government of Saint Vincent to a possible eruption four and a half hours before the event actually took place. But the volcano has been known to erupt without prior earthquake activity and seismic monitoring is thus not an entirely reliable detector of increasing hazard.

In addition to seismic monitoring, ground-tilt measurement may prove reliable in detecting the movement of magma within the volcano. Scientists know that volcanoes inflate and deflate in response to the flow of magma in subterranean plumbing systems, causing changes in tilt. Krafla volcano in Iceland, for example, has experienced no less than nineteen episodes of inflation and deflation since 1975 (the last one on November 18, 1981), and the movement has in some instances amounted to a four-foot subsidence of the center of the volcano.

Ground-tilt measurements of Soufrière were initiated in March 1977 by geologist Richard S. Fiske, of the Smithsonian Institution in Washington, in collaboration with scientists at the Trinidad campus of the University of the West Indies. During the next two years the volcano underwent a steady inflation. In the explosive activity of April 1979 the volcano deflated suddenly to the 1977 level and continued to deflate until September 1980. Since that date the volcano has undergone a steady inflation. These changes in the tilt of the volcano can probably be explained by the continual flow of magma into a magma reservoir about five to ten miles under the crater floor. That there is such a reservoir in this depth range has been confirmed independently by mineralogical studies of rocks thrown out of the volcano. The recognition and location of a magma reservoir under this volcano marks an important step in understanding the dynamics of Soufrière because it tells us the depth range of the magma. That information is useful in the effort to predict future activity in this volcano. The major breakthrough will come, however, when we begin to understand how, why, and when magma is released from this reservoir, to ascend to the surface of the volcano's floor. ☐

ADVANCE COMMISSIONING AUTHORIZATION

TO THE MEADOW

by Lorne McKean

Valid only if postmarked by March 31, 1982. *Limit: One sculpture per person.*

The Franklin Mint
Franklin Center, Pennsylvania 19091

Please accept my commission for "To the Meadow" by Lorne McKean. This original sculpture will be crafted for me in fine hand-finished pewter.

I understand that I need send no money at this time. I will be billed in three monthly installments of $50.* each, with the first payment due before the work is sent to me.

**Plus my state sales tax and $3. per sculpture for shipping and handling.*

Signature ______________________________
ALL ORDERS ARE SUBJECT TO ACCEPTANCE.

Mr.
Mrs.
Miss ______________________________
PLEASE PRINT CLEARLY

Address ______________________________

City ______________________________

State, Zip ______________________________ A

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

DE

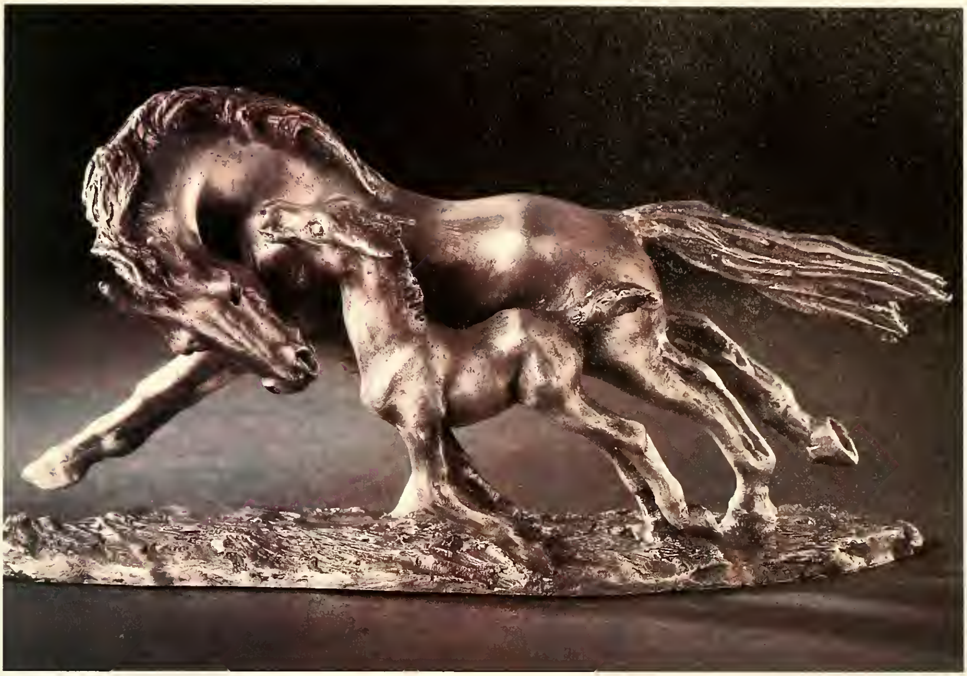
BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 1 FRANKLIN CENTER, PENNSYLVANIA

POSTAGE WILL BE PAID BY ADDRESSEE

THE FRANKLIN MINT
Franklin Center, Pennsylvania 19063

B

Now you can acquire a great sculptor's first work in pewter



ACTUAL SIZE

© 1982 FM

TO THE MEADOW by Lorne McKean

A Limited Edition Sculpture.
Advance ordering deadline: March 31, 1982.

Lorne McKean—one of the world's greatest equestrian sculptors—has created her first work in pewter.

A Fellow of the Royal Society of British Sculptors, Lorne McKean was personally selected by Her Majesty Queen Elizabeth II to create the Queen's Silver Wedding Anniversary gift for Prince Philip. And she recently completed a sculpture from life showing Prince Charles on his horse Pan's Folly. In addition, McKean was chosen to create the first-prize trophy for the International Dressage Championships—one of the world's leading equestrian competitions.

Now, at the height of her career, Lorne McKean has created "To the Meadow," a work capturing both the physical grace and the inner spirit of one of the most admired of all breeds—the American Quarter Horse.

Brilliantly sculptured—and superbly crafted—"To the Meadow" is a sensitive and powerful study of a mare and her foal sharing the excitement of a vigorous run. It has a remarkable vitality and authenticity rarely found in *any* equestrian sculpture. And it is being issued in a single, limited edition.

As the artist's first work in pewter, "To the Meadow" is being made available for only a limited period of time. And the special Advance Commissioning Authorization at the right is valid only until March 31, 1982.

Each sculpture will be accompanied by a Certificate of Authenticity attesting to its status as an original work of art by Lorne McKean and her first work in pewter. And, to further enhance the enjoyment of owning this important work, each collector will also receive a specially-written commentary on the subject of the American Quarter Horse.

The price for this compelling sculpture is $150—a most reasonable price for an original, limited edition work of art by one of the world's most gifted sculptors. And payment for the sculpture may be made in three convenient monthly installments of $50 per month.

A later announcement of this work will be made, but the world-wide closing date is December 31, 1982, after which no further orders will ever be accepted. Thus, the total edition will be permanently limited to one for each person who commissions the work by that date, plus one additional sculpture reserved for the private collection of Lorne McKean.

To acquire "To the Meadow" by Lorne McKean, simply mail the commission authorization at right to The Franklin Mint, Franklin Center, Pennsylvania 19091 by March 31st.

ADVANCE COMMISSIONING AUTHORIZATION

TO THE MEADOW

by Lorne McKean

Valid only if postmarked by March 31, 1982.

Limit: One sculpture per person.

The Franklin Mint
Franklin Center, PA 19091

Please accept my commission for "To the Meadow" by Lorne McKean. This original sculpture will be crafted for me in fine hand-finished pewter.

I understand that I need send no money at this time. I will be billed in three monthly installments of $50.* each, with the first payment due before the work is sent to me.

**Plus my state sales tax and $3. per sculpture for shipping and handling.*

Signature ____________________
ALL ORDERS ARE SUBJECT TO ACCEPTANCE

Mr.
Mrs.
Miss ____________________
PLEASE PRINT CLEARLY

Address ____________________

City ____________________

State, Zip ____________________

24

THE MARKET

Art

ANIMALS ON RUBBER STAMPS. Beautiful designs: Wolf $3; Owl $4; Wildcat $4; Tigar Paw (track) $3; Horse $4; Unicorn $5; Erotic Mermaid $6; Felt Stamp Pad $2; add $1.50 postage. Catalog of rubber stamps depicting famous-infamous people, animals, cowboys, wild-beautiful women, fantasy, horror, military and more, $1 (free with order). Tuckers-NH, Box 849, Pulaski, VA 24301

MADAGASCAR ARTS/CRAFTS. Handcrafted Antaimoro floral paper/stationery. Send $2.00 for sample notecard refundable first purchase. Write Indian Ocean Imports, Box 249, Williamstown, MA 02167

MEXICAN MASKS, Madera, Guerrero, wood, clay, $18 to $75. Request photos, McCoy Imports, Liberty, NY 12754

ORIGINAL BOTANICAL AND NATURAL HISTORY prints by Redouté, Besler, Maria Sibylla Merian, and many others. Send $2 for new, illustrated catalogue to: Florilegium, Box 157 B, Palisades, NY 10964

Pre-Columbian Collectibles!

PARADISE OF TLALOC (200 B.C.-A.D. 900), the Mexican rain God of the Aztecs—only one of many original serigraphs and rubbings of Aztec and Maya ruins! Complete color catalog $2 (deductible with order). **BERNARDO**

2400 Westheimer Suite 108W (NH2)
Houston, TX 77098

WATERFOWL AND BIRDS HANDCARVED and painted by Chesapeake carver. John Blades, 27 Plum St., Easton, MD 21601

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHO, 84 Fifth Avenue, New York, NY 10011.

Books

BOOKFINDING. Librarians search worldwide titles or subjects plus 150,000 indexed stock. PAB, 2918 Atlantic, Atlantic City, NJ 08401 (609) 344-1943

NEW BOOKS REVIEWED. Know what's available before you buy. Latest natural history books, especially wildlife, thoroughly reviewed by scientists in "Fauna." Current issue $3. Fauna Society, Box 895, Rancho Mirage, CA 92270.

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalogue: Hamilton's, 98-55 Clapboard, Danbury, CT 06810

TREASURY OF SATSUMA, hundreds of specimens, over 225 color photos, comprehensive text, marks, glossary, index, hardbound, 8½" × 11". Free Bonus Price Guide. Send $26 to: Sandra Andacht, POB 94, Little Neck, NY 11363

YESTERDAY'S BOOKS LOCATED, no obligation. Out-of-State Book Service, Box 3253J, San Clemente, CA 92672 (714) 492-2976

YORK COUNTY SKETCH BOOK to read, color, and enjoy. $4.25. Gloria Brenneman, 1495 Chapel Drive, York, PA 17404

Camps

FREE—PARENTS GUIDE. Over 400 private resident camps, summer programs, and schools in U.S. and abroad, serving children 6-16. Most visited by publisher. For guide and free referrals give child's age, grade, interests, geographical preference and entrance date. Established 1940. Vincent/Curtis Rm. 216, 224 Clarendon St., Boston, MA 02116.

PRAIRIE TREK (Boys 13-17)—Turquoise Trail (Girls 13-17)—Little Outfit (Boys 10-12). Since 1926 these expeditions have made it possible for young people to explore in the mountains, canyons, and desert country of the American Southwest. Emphasis on environmental studies, archaeology, native crafts, backpacking and camping skills. For details write: Thomas M. Billings, P.O. Box 40451NH, Indianapolis, IN 46240 (317) 896-3842

Collectors' Items

NATIONAL GEOGRAPHICS 1888-1982, issues Book Publications, Collectors Items, Send Wants Buxbaum Geographics, Box 465-NH, Wilmington, DE 19899

SEASHELLS—What to do with the shells you brought home from the beach and where to get more. 40 page color catalog, $3.00 ppd. plus Idea Booklet. Benjane Arts. Dept. NH82, 320 Hempstead Ave., W. Hempstead, NY 11552

Correspondence

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin, West Germany.

MEET SINGLES Mexico, Orient, Europe, Australia. Free information. Write: International, Box 1716-NH, Chula Vista, CA 92012

PENFRIENDS-ENGLAND-USA. Make lasting friendships through correspondence. Send age, interests. Free reply. Harmony, Box 89NH, Brooklyn, NY 11235

SINGLE BOOKLOVERS gets cultured persons acquainted Nationwide. Established 1970. Write Box AE, Swarthmore, PA 19081 or call 215-566-2132

Education

ARCHEOLOGICAL FIELD SCHOOL—8 week field school in archeological excavation on a Western Anasazi site in southwestern Utah. June 14 to August 7. No previous experience required. 15 quarter credits. Non-credit participation by adult avocational archeologists open for 2 to 8 week periods. Total enrollment limited to 20. For cost information write to Dr. Richard A. Thompson, Southern Utah State College, Cedar City, Utah 84720.

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest handbook, $2.00 (guaranteed). Australian International, Box 19107-RM, Washington, DC 20036.

AUSTRALIA—NEW ZEALAND 50,000 Jobs! Big pay Free transportation. Employer listings $2.00. Austco, Box 772-NH, Cypress, CA 90630.

AUSTRALIA . . . NEW ZEALAND want you! - Jobs! - Paid Transportation! - Most comprehensive directory available! - $3 - Moneyback guarantee! "Australia" 2208-C3 Wisconsin Ave, NW, Washington, DC 20007

NUTRITIONISTS—A New Career Field

Be a **Certified Nutritionist**
- Food Stores
- Health Care Facilities
- Schools
- Community Organizations
- Food Service Businesses
- Your Own Nutrition Counseling Practice

Home Study Program Includes
- Physics & Chemistry
- Human Physiology
- Nutrients-Food, Vitamins Minerals
- Diet Management
- Buying/Storage/Cooking
- Nutrition Counseling

Toll free call 1-800-821-5234
312 W. 8th Street
NUTRITIONISTS INSTITUTE OF AMERICA · Kansas City, Mo. 64105

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RN, Washington, DC 20036.

OVERSEAS JOBS—68 COUNTRIES! Hiring now! Paid fare. Computerized reports $2.00. Jobworld, Box 681-NH, Cypress, CA 90630

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . . Intermountain 4Y, 3506 Birch, Cheyenne, WY 82001

TEACH HERE—TEACH ABROAD: School, College openings: USA $5.95; Abroad $5.95. Placement sources: USA $4.95; Abroad $4.95. EISF, Box 662, Newton, Massachusetts 02162

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Kenya. Sampler. 4/$2.98. Free Brochure. Multinewspapers, Box DE-201, Dana Point, California 92629

Garden

WILDFLOWERS, HERBS, FERNS.

Rootstocks, bulbs, plants.
Illustrated catalogue $1,
refundable with order.
NEW ENGLAND
ROOTSTOCK ASSOCIATION
Department H32, Box 76,
Cambridge, New York 12816

Gourmet Interests

ITALIAN PASTA RECIPES (10) from both my grandmothers. Simple and inexpensive. $2.00. B. Ruggiero, P.O. Box 54, Rockaway, NY 11694

MINNESOTA WILD RICE. $7.00 pound, five pound minimum. Floura Bros., Box 44C, Blackduck, MN 56630

Government Surplus

GOVERNMENT SURPLUS! Millions of items (Including Jeeps) . . . low as 1¢ on dollar! Most complete Directory available—$2.00. Disposal, Box 19107-RN, Washington, DC 20036

JEEPS, CARS from $35!—700,000 items! Government Surplus—Most Comprehensive Directory Available Tells How, Where To Buy—Your Area—$2—Moneyback Guarantee—"Surplus Information Services," Box 3070-DC3, Santa Barbara, CA 93105

Merchandise

FOR LOVERS the most intimate book of poems ever written for those in love and those alone. For your copy send $10.00 + $1.50 for shipping to Vanstead, Box 382 Dept N, Freehold, NJ 07728

"I LIKE IT WILD® . . ." Wilderness/wildlife posters, T-shirts, note cards. Send stamped envelope: Wilderness Dreams®, Box 4455-N, Shawnee Mission, KS 66204

Music

OLD TIME RADIO PROGRAMS on cassette tapes. Free catalogue. Cassette Library Center, P.O. Box 5331H, Baltimore, MD 21209

Optical

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON. Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired. Large stock. Orders filled postpaid day received. Birding, Box 5N, Amsterdam, NY 12010

Photography

ELUSIVE OR DANGEROUS WILDLIFE can often be photographed only through unmanned wildlife photography. I build complete, inexpensive units including housing, activators for 35MM SLR's to withstand extreme weather. Photograph mice to grizzlies without being there. Information, material, unmanned photographs, send $4 to: Martin Wildlife Photographics, Rt. 10, Box 374E, Crossville, TN 38555

Real Estate

FREE. BIG SPRING CATALOG! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Recreation, Retirement buys! Selected best throughout the U S Over 700 offices 43 states all across America! Yours free from the world's largest! Strout Realty, Inc , Executive Park Tower, Dept 5390, Albany, NY 12203 Call toll free 1-800-641-4266

FREE CATALOG Describes and pictures farms, ranches, acreages, businesses and town and country homes from coast to coast UNITED FARM AGENCY, INC., 612-U W 47th St , Kansas City, MO 64112. Call Toll-Free· 1-800-821-2599, MO res call Toll-Free· 1-800-892-5785

GOVERNMENT LANDS FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00. Lands, Box 19107-RN, Washington, DC 20036

Rentals

MOUNT DESERT ISLAND, Secluded cottages, electric kitchens, baths, brochure. Kenneth Hutchins, Southwest Harbor, Maine 04679-0393 (207) 244-3831

Resorts

ADIRONDACK LODGES on Upper Saranac Lake Available for two weeks or a month, July through September Everything provided for comfortable living in the quiet woods. $650-$1,700 for two weeks Please write Bartlett Carry Club, RFD 3, Tupper Lake, NY 12986

ALASKAN WILDERNESS FAMILY invites you to share their coastal wilderness. Sincere, informal hospitality in a spectacular sea and mountain panorama The place for those desiring quiet solitude, for birders, naturalists, photographers. 30 foot tides, prolific seabird and marine life Glaciers, nesting eagles, bears, sea otters, seals, whales, untracked beaches, forest trails. Pull in crab and shrimp pots, catch salmon, trout, halibut; dig clams, gather mussels. An in-depth, educational experience 8 guests only $1125.00/5 days. Cozy cabins, gourmet meals. Called America's best wilderness lodge. The McBrides, China Poot Bay via Box 956NH, Homer, AK 99603, radio/phone (907) 235-8910 Write for brochure

DISCOVER COSTA RICA! Experience the allure of our secluded tropical paradise. Explore jungle trails rich in flora and fauna Enjoy sun-bathed Pacific beaches New, modern accommodation, swimming pool, and cordial hospitality in a tropical wilderness setting Booking agent. Las Ventanas De Osa, Box 820, Yellowknife, NWT, Canada XOE 1HO (403) 873-2595

IDAHO WILDERNESS. Small family homestead on beautiful Selway River No roads. Access by horseback along historic Nez Perce Trail Comfortable cabin accommodations, home-style meals, fishing, riding, hiking, rafting. Two weeks (minimum) - $750. Selway Lodge, Box 1100-H, Hamilton, MT 59840

LITTLE ST. SIMONS ISLAND

One of Georgia's "Golden Isles"

Birding, beachcombing, riding, wildlife photography, fishing or just relaxing on a secluded 12,000 acre island with miles of unspoiled ocean beaches, forests and marshes Over 200 species of birds Maximum of 10-15 guests at a time. Excellent food and accommodations Professional naturalists on the staff. **Little St. Simons Island** P O. Box 1096N, St. Simons Island, GA 31522

OLD FASHIONED, Secluded Farm on Cape Breton Island offers log cabins, excellent meals, peace to a few guests. $250/week Write: John Gardner, Orangedale, Nova Scotia.

SUPERB BIRDING—Resident naturalist, Musky fishing, highly rated small luxury full-service lakeside resort in National Forest, heated pool, tennis, NO speed boats or waterskiing. Ross' Teal Lake Lodge, Rt7nh, Hayward, Wis. 54843 (715) 462-3631

WESTERN ADVENTURE on authentic ranch. Fun for all ages. Operating stock ranch 50 miles north of Yellowstone Park A birders paradise Riding, fishing, pack trips All ranch activities 63 Ranch, Box NH979, Livingston, MT 59047 Tel 406-222-0570

Tours/Trips

ADVENTURE TRAVEL: Tanzania, Camping Safaris, Peru natural history, Himalayan Treks, Australian Adventures. Special birdwatching and natural history departures Overseas Adventure Travel, 1430 Mass. Ave. #303N, Cambridge, MA 02138. (617) 876-0533

ALASKA NATURAL HISTORY CAMPS, North Slope and Misty Fjords. Washington wildflowers. Hawaiian Gardens Horticulture Tours Brad's Tours, 401 E Mercer #31D, Seattle, WA 98102

ALASKAN WATER ADVENTURES. Kayaking, Rafting, Birding in Prince William Sound and Copper River Basin. Open Door, Box 1185N, Cordova, Alaska 99574 (907) 424-7466

ALPS OF SWITZERLAND "The Hiker's Paradise." Moderate optional length day hiking tours, two or four weeks. Brochure Alpine Adventure Trails Tours, 783P Cliffside Drive, Akron, OH 44313

BACKPACK AND LEARN in the River of No Return Wilderness, Idaho Join one of our six or ten day hikes through this spectacular 2½ million acre treasure. Trips for all abilities, everything provided, and small groups Write Wilderness Trails, POB 9252N, Moscow, Idaho 83843 208-882-1955

CANOE CANADA'S ARCTIC. Remote fly-in canoe expeditions in the heart of North America's last great wilderness—the tundra and taiga of Canada's Northwest Territories Photograph caribou herds, white wolves, muskox, moose, grizzlies, rich birdlife Spectacular fishing Groups of 6 or 8 persons assembled and guided by Alex Hall, wildlife biologist and veteran arctic canoeing guide All food and equipment provided. Can accommodate a limited number with no previous canoeing experience. Twelve days from $1,051.00, eighteen days from $1,813 00. For brochure write: Canoe Arctic Inc., Box 130 (C), Fort Smith, NWT, Canada XOE OPO.

CANOE TRIPS in wilderness Nova Scotia July-September. Small groups with licensed guides Excellent food Write· Granville Nickerson, RR4N, Annapolis Royal, NS BOS 1A0, Canada

CHINA BICYCLE TOURS. Easy-going cycling through Chinese countryside, ideal for wildlife observation. 19-23 days from $1275 inclusive plus airfare. Some spring dates still open China Passage, 302 Fifth Avenue, NY, NY 10001 (800) 223-7196 or (212) 564-4099

COLLEGE CREDIT BACKPACKING COLORADO Mountaineering Natural History Packstocking 17-70 Yrs 5 days $25/day Alpenglow Educational Adventures, 139N Adams, MonteVista, CO 81144

EXPLORE THE ROCKIES· Small group workshops in environmental and photographic topics. Packhorses, backcountry College credit available. Write: Scientific Educational Expeditions (SEE), 2715 Parklake Ct , Fort Collins, CO 80525

FREIGHTER CRUISES—First Class—Exotic—$50 daily and less. TravLtips Freighter Association, 16309-B5 Depot Road, Flushing, NY 11358

GALAPAGOS. Explore with Scripps Aquarium. Land & Sea Professional ecologist escort. Arranged by Lindblad Tours. Nov. 17-Nov. 30, 1982. Write Scripps Aquarium, La Jolla, CA 92093

GALAPAGOS HIKING AND SAILING EXPEDITIONS. Small groups. 1982 dates: February 4, April 22, July 7, August 4 Charters: Machu Picchu options and Chili ski options. Inca Floats, 5982N Balboa, Oakland, CA 94611 (415) 339-9095

GALAPAGOS ISLANDS. Economic guided tours from $1638. Including airfare. 4, 5, 8, & 15 days Galapagos, all meals Options, mainland Ecuador, Amazon, Cuzco/Machu Picchu. University credit available. Joseph Colley, Last, Inc., 43 Millstone Rd., Randallstown, MD 21133. 301-922-3116.

GORILLAS IN RWANDA—African Photo safaris viewing gorillas in Rwanda, wildlife and birds in Kenya, Tanzania, Zambia, Botswana, and Madagascar. Brochure with 25 trips. Adventures International, Dept NC, 4421 Albert, Oakland, CA 94619

HIKE THE SWISS ALPS Swissair flies you to special hiking tours, led by author/mountaineer, Fred Jacobson Zermatt, Lenk, Saas-Fee, Kandersteg, Pontresina, and Wengen Beautiful and challenging trails. Delightful country inns. Superb cuisine. 10th summer! Write: Jacobson, Dept. K, Chappaqua Travel, 24 S. Greeley Ave , Chappaqua, NY 10514

INDIA/NEPAL WILDLIFE SAFARI: Outstanding game observation in three major reserves + Delhi, Taj, Kathmandu, Himalayas. $1375.00. Also, comprehensive program of trekking expeditions in Nepal's Everest & Annapurna regions from $895.00. Airfares additional. Free brochure Himalayan Travel, Inc., Box 481-NH, Greenwich, CT 06830 Toll Free (800) 243-5330

MAINE WINDJAMMER VACATIONS, June and August, 1982. Reservation deadline April 1, 1982. New Jersey Audubon Society, Box 125, Franklin Lakes, NJ 07417. Free brochure 201-891-1211

MT ST. HELENS—NATIONAL PARKS TOUR with geologist-educator, Rich Little, SASE: 36 Plantation Circle, Greenfield, MA 01301

RAFT & KAYAK IDAHO'S SALMON RIVER—exciting rapids & serene floating through majestic mountain landscapes Brochure· SALMON RIVER OUTFITTERS, Box 307N, Columbia, CA 95310 (209) 532-2766

SERENGETI: MIGRATION OF WILDEBEEST 1982 departures Send for details. Overseas Adventure Travel, 1430 Mass Ave #303N, Cambridge, MA 02138 (617) 876-0533

SITES & SCENES: LATIN AMERICA/AFRICA/EUROPE/CHINA. Largest program of uncommon nature and culture trips (including Trekking and Special Interest Tours) at unbeatable prices, for groups or individuals. Favorites: Peru (Machu Picchu, Amazon, Titicaca, Nazca). Ecuador (Galapagos, Devil's Railroad). Colombia ("Lost City," San Agustin). Costa Rica (Tropical Treasure). Madagascar ("Land of Living Fossils"). Kenya/Tanzania Safaris. Rwanda/Zaire (Gorilla Tracking). Greece/Turkey (textile arts, archeology). Forum Travel, 2437 Durant, Berkeley, CA 94704 415-843-8294

SMOKY MOUNTAIN FIELD SCHOOL. Intensive 5-day and 2-day field workshops in the Great Smoky Mountains National Park Includes Wild Mammals, Birds, Natural History, and many more Co-sponsored by Smoky Mountains National Park and University of Tennessee Continuing Education Division, 2016 Lake Ave., Knoxville, TN 379963515. (615) 974-6688

SUMMER IN YELLOWSTONE. Join us in Yellowstone National Park for field seminars on wildlife, geology, plants, art, photography, history, etc. Accommodations at Park Service facility. Academic credit available The Yellowstone Institute, P.O. Box 515, Yellowstone National Park, WY 82190

WILDERNESS CANOE TRAVEL Alaska, Maine, and Canada Completely outfitted trips with small groups. Northern Rivers, Box 326, Orono, ME 04473

RATES AND STYLE INFORMATION

$1.75 per word; 16 word ($28) minimum. *Display classified* is $150 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024 Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—1st of the month, two months prior to cover date (the January issue closes Nov 1). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon request.

Free!

Edmund Scientific Catalog

Edmund Scientific Catalog
4,000 Items For Hobbyists, Schools & Industry

4,000 Unique Items

Astronomy, Microscopy, Biofeedback, Weather, Alternate Energy, Binoculars, Optics, Magnets, Magnifiers, Tools, Unique Lighting, Lab Equipment, and much more. Over 4,000 unique and fascinating products. Send for our **FREE**, colorful 1982 Edmund Scientific Catalog. . .Today!

Rush me your free catalog!
Name __________
Address __________
City __________
State __________ Zip __________

Clip And Mail Coupon Today To:
Edmund Scientific Co., Dept. 8211E-06
Edscorp Bldg., Barrington, N.J. 08007

No. 3455 ©1982 Edmund Scientific Co.

The Garden Way® Cart

runs circles around the wheelbarrow!

With this perfectly balanced Cart as your "constant companion" you'll be able to tackle all those back-breaking jobs with incredible ease! Build stone fences, move dirt, gravel, compost, and mulch for the garden.

Nearly every job is a joy when you use this BIG new Cart. Easier to handle than the common wheelbarrow.

Also available in do-it-yourself kits.
Send Now for free Cart Literature.

© 1982 Garden Way Inc

3 SIZES AVAILABLE

01
Garden Way Research
Charlotte, VT 05445, Dept. A1752C

Name __________
Address __________
City __________
State __________ Zip __________

Curious Wonders

by Joseph Kastner

To THE ENDS OF THE EARTH, by John Perkins. *Pantheon Books, $27.50; 183 pp., illus.*

If you have already seen a unicorn's horn or camels en route from Xanadu or a naked queen being adorned by her ladies-in-waiting, then you may not want to bother with *To the Ends of the Earth*. Besides, there are plenty of books that take you, with little effort, to the farther places of this world. Their stunning color photographs confront you with the beauty of jungle and tundra and with the drama of the cameraman's ever present art. *To the Ends of the Earth*, however, stands apart from these books. The beauty of its photographs lies in their honest, black-and-white plainness. Their drama comes, not from the cameraman's art, but from his innocence. And they are full of curious wonders.

The book is a collaboration, as the title page puts it, "by John Perkins with the American Museum of Natural History." Perkins provides the text, the Museum supplies the photographs. Most of the photographs were taken on four historic explorations of lands that, at the time, really seemed to be the ends of the earth, reached only by great courage and labor, not easily arrived at by plane or four-wheel drive.

Robert E. Peary tried four times to reach the North Pole before he got there in 1909, braving cold that froze his brandy and crossing untried ice that bent and wavered as he went over it. When he "knew for a certainty" that he was at the Pole, he said, "there was nothing in the world I wanted but sleep."

Herbert Lang and James Chapin, from 1909 to 1914, went the length of the Congo (now the Zaïre) River. They came back to the Museum with fifty-four tons of skins, skeletons, carcasses, and artifacts, along with 10,000 photographs of that overheated land and some words of advice. "While looking at these pictures," Lang said, "get into a Turkish bath. You will understand the country better."

Roy Chapman Andrews first went to the Gobi Desert to hunt mammals for the Museum but kept stumbling on evidence of fossils where scientists said there couldn't possibly be any. He went back in the 1920s to make sure and found, in the rich lodes of ancient stones and bones, the first dinosaur eggs ever known and the skeleton of a pregnant mastodon containing the skeleton of her unborn baby.

Waldemar Jochelson and Waldemar Bogoras scoured eastern Siberia for clues to any connection between the people of Asia and America. Both of them had been Russian revolutionaries exiled to Siberia for plotting against the czar. Exile was more relaxed in those days. They were permitted to wander freely, studying the natives, so when the Museum hired them in 1899, they had a head start on the job.

What these disparate explorers did for the cause of science is less the point of the book than where they went and what sights they brought back. From

J. Makenzie Young

first to last we are reminded by their photographs that we really are seeing the earth's imagined ends. The opening picture is of a distant arctic shore in an almost domestic moment. Sleds are parked neatly on a floe, dogs meandering about. But past the barren ice are distant mountains—except that they may not be mountains but monstrous icebergs or, maybe, not even icebergs but mirages. The book's last photograph is of a camp of the Reindeer Chukchee of Siberia. Inside the photograph's torn borders are four hide tents. Everything else stretches into the empty infinity of Ultima Thule.

In between the opening and closing photographs are images that somehow sort themselves out into pairs. For example, a pairing of animals: a Greenland narwhal, with its single grooved tusk protruding four or five feet from the middle of its forehead, as if it were a misplaced unicorn horn; and a Mongolian bighorn ram, just shot, with its imperious face and whorled antlers still proclaiming it king of the mountain. Or a pairing of women: fur-swathed Eskimo ladies, with their bashful half smiles; and a Congo queen, who had lain with three kings, standing unabashedly bare, with huge pendant breasts, while attendants delicately trace designs on her skin. Or of local styles: polar Eskimo boys in their shiny, inside-out bearskins; and a Bangba dude in his chic hat of water-snail shells. Or of mythic wealth: an ivory palisade of elephant tusks, each taller than the carrier who props it up; and a camel caravan winding, as Kublai Khan's once did to Indus or Samarkand, below the flaming cliffs of Outer Mongolia.

Cars and cavalry escort an expedition in North China near the Great Wall

In 1974 we originated our epoch-making ***Galapagos Islands Thrift Cruises****, which for several years enabled many hundreds of budget-minded travelers who were interested in ecology, wildlife and photography to see these unique islands without luxurious trimmings but under expert guidance.*

We now again offer a budget program which includes some of the highlights which make a visit to this remarkable archipelago such a renowned tourist attraction. We explore five of the islands in order to view sea lions, iguanas and a large variety of birds, such as the famous Darwin's finches, boobies, frigates and gulls.

Galapagos Islands
Thrift Program

APRIL 4 TO 14, 1982
JUNE 27 TO JULY 7, 1982
DECEMBER 26 TO JANUARY 5, 1983

Our program includes easy hikes on Santa Cruz to see tortoises roaming free and to the top of the dormant volcano at Sullivan Bay, and ample opportunities for swimming and snorkeling. It is ideal for young people and families with children and has been planned during periods of school and college vacations.

We do not claim that these programs are as comprehensive as our superb and unrivalled **Discover Galapagos** yacht cruises in August and October, 1982; but our meticulously supervised arrangements do provide you with a fascinating introduction to these wonderful islands—and at a third of the cost.

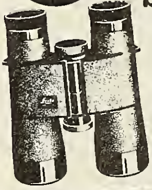
Each program is accompanied by one of our expert leaders and a naturalist guide who give informative talks and lead us in the field.

Before the week at the islands, we spend two days at the best hotel in Quito, Ecuador's lovely capital in the Andes.

Please send for the detailed brochure of these programs—we also specialize in expeditions to Greenland, Mount Kilimanjaro, the Himalayas and the Andes; wildlife safaris to see polar bears and seals in northern Canada and to Scotland, Borneo and Rajasthan; and archaeological tours to Peru, Morocco and Eqypt.

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

Leitz **TRINOVID**
Our finest binocular?



Compact, precise, they give you sparkling crisp clarity and exceptionally true color rendition.
Many people consider them the finest you can buy. Because most of them already own Trinovids. Find out why.
Write to the "optics headquarters for the bird watcher" for literature and deep discount prices.

BIRDING
P.O. BOX 5-HI
AMSTERDAM, N.Y.
12010

AUSTRALIA.
CIVILIZED
ADVENTURE.

Australia is unlike any other place on earth. You can walk back into time and leap into the future. All in the same day.

Join a rugged safari tour. Experience spectaculars like the vast Outback. The Great Barrier Reef. Living deserts and tropical rain forests.

Go game fishing, mountain climbing, camel-trekking. Ride around a sheep station. Pan for gold. Or hop off the trail and explore one of our cosmopolitan cities.

Send for our free Travel Planner. And take a tour of our continent before you come, mates.

See your Travel Agent or mail this coupon for your free Travel Planner.

Australian Tourist Commission
Distribution Center, P.O. Box A-1,
Dept. 151D-013, Addison, IL 60101

My special interest is ______

Name ______

Address ______

City ______ State ____ Zip ____

Carving & Sculpture
Drilling
20" Model 710 Bandsaw
Saws

Our catalog doesn't just sell you things. It teaches you things. The Garrett Wade Catalog is a new, 212-page collection of woodworking hand tools, machinery, finishing supplies and accessories that are simply the finest available. Anywhere.

And besides offering quality tools from around the world, we also give you a lot of quality advice. On woodworking techniques. On picking the proper tool for a particular job. On finishing, sharpening, clamping and more.

The catalog is filled with superb photography, honest specifications and reliable descriptions. It's neatly divided into seventeen sections, including a section on our Swiss INJECTA INCA power tools. And throughout the year, our catalog owners will receive several handy supplements–*free of charge.*

Just send in the coupon below with $3.00, and we'll send out your copy of the 1982 Garrett Wade Catalog. It just may prove to be the most useful tool you own.

Garrett Wade Co., Dept. 58
161 Avenue of the Americas
New York, N.Y. 10013

Garrett Wade Company · The Yankee Wood Craftsman

Gentlemen:
Send your complete 212-page catalog of woodworking tools, machinery, and accessories. Enclosed is $3.

☐ I would like *only* the following sections of the catalog, for 50¢ each:
☐ INJECTA INCA ☐ Carving ☐ Finishing

Enclosed is $______

Name ______

Address ______

City ______

State ______ Zip ______

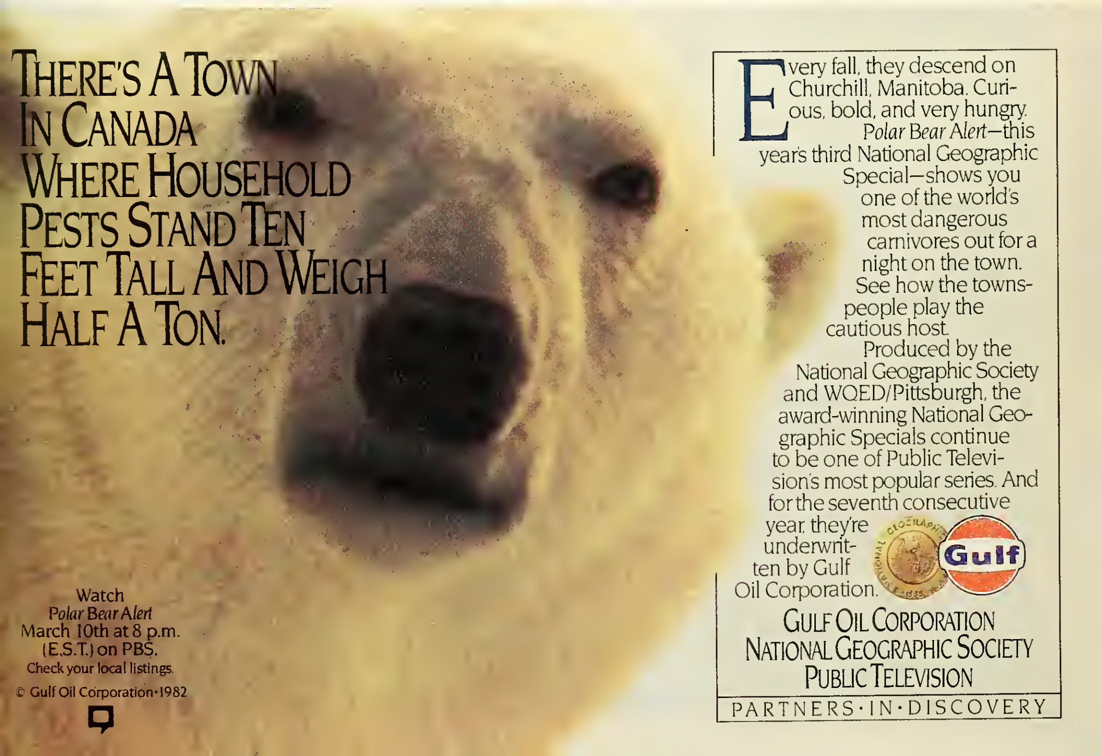
Donald B Macmillan

The space in this book—this fascinating and exasperating book—is evenly shared by the collaborators. One page is given to a photograph, the facing page to the text. But the honors are not equally divided. They go to the photographers whose pictures are absorbing and have a consistent point of view. Lang and Bogoras took those of their expeditions. Peary took several of his, and Andrews a few of his. They were almost all taken straight on, with thought but no self-consciousness, and with wide-eyed appreciation of what was there. The Perkins text is inconsistent, wandering all over the place. This results from the author's decision, sensible in itself, not to restrict himself to the story of the expeditions. He includes history, lore, excerpts from the writings of Livingston, Stanley, Frobisher, Bering, and many other explorers. But he also lapses into irrelevancies that are often puzzling, not always interesting, and in the end, irritating. A fetching photograph of the twelve wives of King Kasima is faced with Stanley's description of the perils he encountered while in Africa, which has nothing to do with the case. Along with a picture of elephant tusks is the news that mammoths once lived in Stone Age Czechoslovakia,

Dog teams haul sledges up a steep grade in northwest Greenland

which is ho-hum. Peary's eloquent remark as he set out for the Pole, "Everything in my life appeared to have led up to this day," is opposite a photograph of another expedition at another time, which is misleading.

All this dampens the many pleasures Perkins gives with his narratives and his evocative bits and pieces of history. He tells of a Congo Joan of Arc, a missionary convert named Beatrice, who announced that she was possessed by the spirit of the patron saint of Portugal, gathered a great following, tried to restore a young king to his throne, and failing, was burned to death, declaring: "What does it matter to me to die? My body could come to no other end. It is only a bit of earth." There is the bit about the caravan guides who, if uncertain about their whereabouts, would poke their noses into the soil and would know from its smell if they were on the right road. And it is worth wading through a long chronicle of Genghis



THERE'S A TOWN IN CANADA WHERE HOUSEHOLD PESTS STAND TEN FEET TALL AND WEIGH HALF A TON.

Every fall, they descend on Churchill, Manitoba. Curious, bold, and very hungry.

Polar Bear Alert—this year's third National Geographic Special—shows you one of the world's most dangerous carnivores out for a night on the town. See how the townspeople play the cautious host.

Produced by the National Geographic Society and WQED/Pittsburgh, the award-winning National Geographic Specials continue to be one of Public Television's most popular series. And for the seventh consecutive year, they're underwritten by Gulf Oil Corporation.

GULF OIL CORPORATION
NATIONAL GEOGRAPHIC SOCIETY
PUBLIC TELEVISION

PARTNERS · IN · DISCOVERY

Watch
Polar Bear Alert
March 10th at 8 p.m.
(E.S.T.) on PBS.
Check your local listings.

© Gulf Oil Corporation · 1982

THE ALGARVE
SUN-DRENCHED. SOPHISTICATED.
SENSATIONAL.

It's 100 miles of powder-white beaches, framed by towering promontories, quaint hamlets and fragrant almond trees. Where you dine elegantly, swim, lounge, and do everything under a summery sun at unbelievable prices. For more about the Algarve, mail in the coupon.

PORTUGAL
A VACATION
WELL SPENT

Name________________
Address________________
City__________ State__________ Zip__________

Portuguese National Tourist Office, 548 Fifth Avenue, New York, N.Y. 10036.
Offices also in Los Angeles and Chicago.

¡Speak Spanish like a diplomat!

What sort of people need to learn a foreign language as quickly and effectively as possible? *Foreign service personnel*, that's who. Members of America's diplomatic corps are assigned to U.S. embassies abroad, where they must be able to converse fluently in every situation.

Now you can learn to speak Spanish just as these diplomatic personnel do—with the Foreign Service Institute's Programmatic Spanish Course.

The U.S. Department of State has spent thousands of dollars developing this course. It's by far the most effective way to learn Spanish at your own convenience and at your own pace.

The Programmatic Spanish Course consists of a series of cassettes and accompanying textbook. Simply follow the spoken and written instructions, listening and repeating. By the end of the course, you'll be learning and speaking entirely in Spanish!

This course turns your cassette player into a "teaching machine." With its unique "programmatic" learning method, you set your own pace—testing yourself, correcting errors, reinforcing accurate responses.

This Programmatic Course comes in two volumes. Order one or both.

☐ **Volume I: Basic.** 12 cassettes, (17 hr.), 464-page text, plus manual, $115.

☐ **Volume II: Intermediate.** 8 cassettes, (11½ hr.), 614-page text, plus manual, $98.

(Conn. and N.Y. residents add sales tax)
Shipped in handsome library binders.

TO ORDER, JUST CLIP THIS AD and mail with your name and address, and a check or money order. Or, charge to your credit card (American Express, VISA, MasterCard, Diners Club) by enclosing card number, expiration date, and your signature.

The Foreign Service Institute's Spanish course is unconditionally guaranteed. Try it for three weeks. If you're not convinced it's the fastest, easiest, most painless way to learn Spanish, return it and we'll refund every penny you paid. Order today!

Many other FSI language courses also available. Write us.

AUDIO-FORUM®

Audio-Forum
Suite 243
On the Green,
Guilford, CT. 06437
(203) 453-9794

Or visit our New York sales office: 145 E. 49th St., New York, N Y 10017 (212)753-1783

Makere man from northeast Zaïre holds a crowned eagle

Khan and his grandson Kublai Khan to come to a description of Xanadu by a French priest who was there half a millennium after Marco Polo had visited its pleasure domes. It is, reported the priest in 1845, "a large, busy, bustling dirty town with a great manufactory of images of Buddha."

In an odd way, *To the Ends of the Earth* can serve as a fine supplementary guide to the Museum. A natural history museum—all talk about education and scientific research and cultural enhance-

Herbert Lang

ment notwithstanding—is really a place for browsers. They go about the halls, sampling the sedate exhibits and wondering what lies beyond the labels. Now, having gone through *To the Ends of the Earth*, they will find the still lifes suddenly animated. They will never look at a jungle diorama again without conjuring up Saint Beatrice in the flames. Or look at a representation of a Mongol horseman without seeing him, down on his knees, sniffing at the untracked sand to find out if he had made the wrong turn to Samarkand.

Joseph Kastner, a former editor of Life, *and that magazine's first nature editor, is the author of* A Species of Eternity *(Knopf), a history of early American naturalists.*

INVEST IN THE LUXURY OF SOLID GOLD

The Celebrated Swiss Gold Ingot Wristwatch

Hand-Crafted from an Ingot of Solid 24 Karat GOLD

CREDIT SUISSE
5g
FINE GOLD
999,9
ESSAYEUR FONDEUR

Enlarged to show detail.

CREDIT SUISSE
FINE GOLD
999,9

Individually numbered and authenticated by the Credit Suisse Bank of Switzerland.

NOW YOU CAN OWN ONE OF THE WORLD'S MOST EXCLUSIVE TIMEPIECES

The Swiss Gold Ingot Watch is a modern legend. Relatively few are made each year. The production is strictly controlled *because the face of each watch is a genuine Swiss Gold Ingot*—a solid block of pure 24 karat gold, individually numbered and authenticated by the Credit Suisse bank in Zurich, and accompanied by the bank's Certificate of Authenticity to that effect. They are so rare, you may be the only one you ever meet who owns one. A triumph of the watchmaker's art, each Swiss Gold Ingot Wristwatch contains a quartz movement so precise *it is accurate to an incredible three seconds per month.* Because the face of your watch is made from an ingot of solid 24 karat gold, you can be confident that today. . . next year . . . even 50 years from now. . .the value of the gold content in your Swiss Gold Ingot Watch will be as valuable as the gold content in a South African Kruggerrand, U.S. Double Eagle or any other solid 24 karat gold coin, gold ingot or gold bullion. The Swiss Gold Ingot Wristwatch: A splendid compliment to your self-esteem. A perfect gift for that Special Someone in your life. An investment in luxury as good as gold. Price $149.95.

Please send the Swiss Gold Ingot Watches indicated below under your 30-day money back guarantee. [Price guaranteed only until May 25.]

☐ 1 gram 24K Gold Swiss Ingot Watch only **149.95** (women's only) **(A20370)** QTY.______

☐ 5 gram 24K Gold Swiss Ingot Watch only **349.95**

Men's **(A20381)** QTY. ______

Women's **(A20382)** QTY. ______

☐ 10 gram 24K Gold Swiss Ingot Watch only **549.95**

Men's **(A20391)** QTY. ______

Women's **(A20392)** QTY. ______

Total of $ ________ **enclosed**
(Include $5 shpg. & hdlg. for each watch)
Or charge to my ☐ **VISA** ☐ **MASTER CARD**

Card # ____________ **Exp. Date** ____

Name ____________

Address ____________

City ________ **State** ______ **Zip** ______

MAIL TO:
Swiss Gold Marketing Council, Ltd.,
Swiss Gold Ingot Watch, Dept. 569-17,
Box 256, Jericho, New York 11753

☎ For faster service, VISA or Master Card charge orders may call TOLL-FREE—24 hours a day:
1-800-645-3197, Ext. 582
(In New York State, 1-800-228-2028, Ext. 582)

(A20400)

© 1982 Swiss Gold Marketing Council, Ltd

Share the Thrills of Exploring Outer Space!

$359.95 f.o.b. Hartford, Conn.

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

Criterion Manufacturing Co.
620 Oakwood Ave., W. Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION, MANUFACTURING CO., Dept. NH 112
620 Oakwood Avenue, W. Hartford, Conn. 06110
Please send your free Telescope Guide.

Name__________
Address__________
City__________State__________

AlaskA
TRAVEL ADVENTURES

Where Adventure Begins
We feature:

- Backcountry Adventures
- River Trips
- Inside Passage
- National Parks
- Fishing

Call for free brochure describing 50 adventures:

Toll-Free: 800-227-8480
Northern Cal.: 415-329-9013 (collect)
Southern Cal.: 213-859-3959

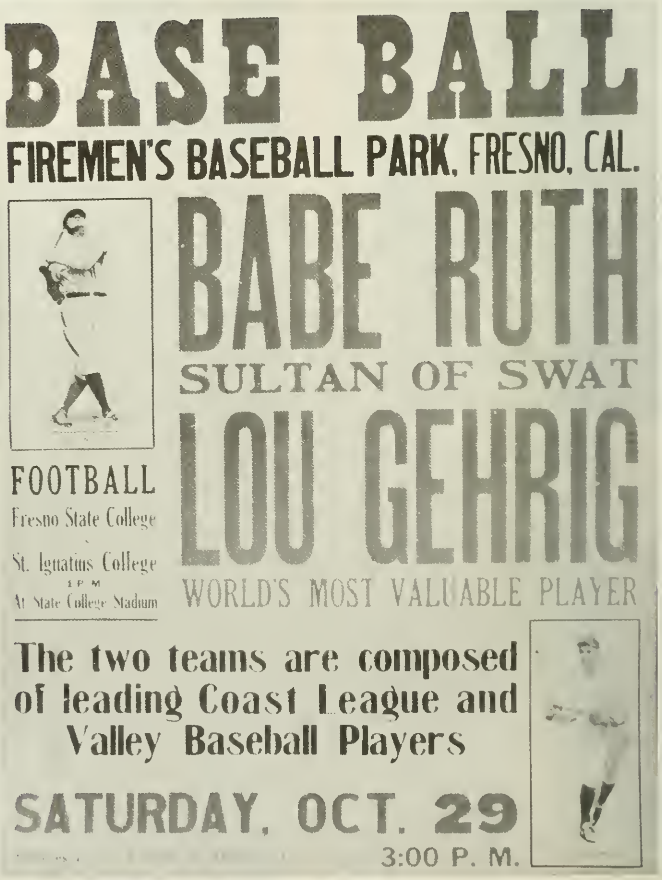
Alaska Travel Adventures
525 University Ave. #610-M
Palo Alto, CA 94301

NORTHWEST ORIENT
THE WORLD IS GOING OUR WAY!

Champions of American Sport

In 1930, when Babe Ruth's salary peaked at a record $80,000, someone commented that he was earning $5,000 more than President Herbert Hoover. "Yeah," said the Babe, "but I had a better year than he did."

Today, top sports figures still earn more money than the president and are often more beloved by the American people. Sports figures—more than statesmen, politicians, or generals—are America's cultural heroes. A touring exhibition called *Champions of American Sports*, opening March 19, in Gallery 3 of the American Museum of Natural History, presents this American cultural phenomenon in all its glory. The first major exhibition of its kind, *Champions* portrays 100 American sports heroes and offers glimpses of their tri-



BASE BALL
FIREMEN'S BASEBALL PARK, FRESNO, CAL.
BABE RUTH
SULTAN OF SWAT
LOU GEHRIG
WORLD'S MOST VALUABLE PLAYER

FOOTBALL
Fresno State College
St. Ignatius College
1 P. M.
At State College Stadium

The two teams are composed of leading Coast League and Valley Baseball Players

SATURDAY, OCT. 29
3:00 P. M.

Poster courtesy of National Baseball Hall of Fame and Museum, Inc., Cooperstown, N.Y.

umphs and defeats, the history of their sports, and the hoopla and hype that attended their careers.

Visitors will find the baseball bat with which Babe Ruth hammered twenty-eight homers, a 1938 Maserati that twice won the Indy 500, Muhammad Ali's robe, Johnny Weismüller's five Olympic gold medals, Willie Mays's Golden Gloves award, uniforms with numbers made famous by their wearers, assorted boxing programs, baseball cards, posters, and sheet music. For the more serious-minded viewer there will be art that relates to sports—including works by Thomas Eakins, Andy Warhol, Norman Rockwell, N.C. Wyeth, and Frederic Remington. Great sports photos by Neil Leifer, Robert Riger, and Fred Kaplan are also included.

The athletes honored in the exhibition were, by and large, an odd lot. Babe Ruth, for example, was notorious for his gluttony, and in 1925 caused an uproar among his fans when he nearly died after eating too many hot dogs and drinking too much soda pop. Casey Stengel, another beloved baseball personality, was known for his clowning. He once hailed a hostile crowd by tipping his hat to release a sparrow trapped underneath.

Sharing the stage with these well-known figures are once famous athletes who are now largely forgotten. Edward Payson Weston, a record-setting walker, was a familiar sight to many nineteenth-century Americans. He unwittingly began his career when he bet that Abe Lincoln would lose the election; to pay off his wager Weston had to walk from Boston to Washington in ten days to attend the inauguration. The dapper Weston, outfitted in a short jacket, tight breeches, silk derby, and gloves, attracted audiences for decades. At the age of seventy he walked from New York to San Francisco, a distance of 3,895 miles, in 104 days, and then a year later retraced his steps in 77 days.

The first woman to swim the English Channel was New York-born Gertrude Ederle. She beat the world's record time

The Mark of a True Book Lover

Sale!
SAVE
25%

Actual Size 1½"

This is the same heavy duty, chrome plated embosser used by professional librarians to mark and identify books.

Now you can have one with your own name and initials on a 1½" diameter seal. It's easy to use. . . simply insert the page, squeeze the handle and "LIBRARY OF (your name)" and initials will be clearly embossed (see photo).

Thousands sold at $20 or more!

Now Only $14.95 ea.

This quality embosser is fully guaranteed and comes with a handsome storage pouch.

A great gift for all book lovers. . . including yourself!

Please allow 3 to 5 weeks for delivery.

How do you want your seal to read?

Print name and initials below exactly the way you want them to appear

NAME

INITIALS

For additional embossers, simply print names and initials on a separate sheet of paper.

Check One

☐ A check or money order is enclosed
☐ Please charge this purchase to:

☐ VISA ☐ American Express Card ☐ MasterCard

Account #

MasterCard
4 digits above your name

Exp. Date ______ Signature ______

BARNES/SALE
& NOBLE/ANNEX
126 FIFTH AVENUE DEPT. E175
NEW YORK, N.Y. 10011

Please send me______ embosser(s) at only $14.95 each plus $1.75 each for postage and insurance. (N.Y. and N.J. residents: Please add sales tax.)

Name ______
Address ______
City ______
State ______ Zip ______

Offer good only in the continental U S A 0038158
© 1981 Barnes & Noble Bookstores, Inc.

THE THRILL OF EUROPEAN ROADS. THE JOY OF EUROPEAN PRICES.

We'd like to suggest a more attractive location in which to pick up your BMW.

Europe. Where you can slalom over winding Alpine roads. And blur the scenery along high-speed German autobahns.

A purely extravagant notion?

Hardly. Acquiring a BMW in Europe can save you as much as $4,000. Enough to pay for your entire trip.

And since your local dealer arranges everything, your trip will not only seem expense-free but carefree as well.

For more information, send this coupon to BMW of North America, Marketing Services Department, Montvale, New Jersey 07645.

NAME______
ADDRESS______ NAT 3
CITY______
STATE______
ZIP______

THE ULTIMATE DRIVING MACHINE.
BMW, MUNICH, GERMANY

© 1981 BMW of North America, Inc. The BMW trademark and logo are registered trademarks of Bayerische Motoren Werke, A G

ARAB
CAPITAL
AVAILABLE

We have a list of potential clients from all over the Arab world who have shown interest in promoting, funding, buying and investing in all sorts of real estate projects, or any other worthwhile profit-making venture in North America. We will send you this very select list for **$190.**

IAAIC
8306 Wilshire
Blvd. Suite 198
Beverly Hills,
CA 90211

Satisfaction guaranteed
or money refunded

for this feat by two hours, even though tidal currents forced her to swim thirty-five miles to cover the twenty-one mile distance. A spinal injury and deafness prematurely ended her career. She said of her fans, "It doesn't matter if they have forgotten me. I haven't forgotten them."

The exhibition includes figures from a few lesser-known sports. In polo circles, Tommy Hitchcock is considered one of the greatest American polo players who ever lived. Between the two world wars, Hitchcock turned polo from an aristocratic game with a limited following into a mass spectator sport, attracting crowds in the tens of thousands. He once scandalized the upper-crust polo world by adding two Texas cowboys to one of his teams.

In the late nineteenth century, bicycle racing was America's favorite spectator sport, and the most famous racer was A.A. ("Zimmie") Zimmerman. He took up racing shortly after the invention in 1884 of the "safety," as opposed to the "high wheel," bicycle and was nationally known by 1893. In that year alone,

The Last and First Eskimos

A major symposium entitled *The Last and First Eskimos—A Native American Culture in Transition* will be presented at the Museum on Saturday, March 27, in the Education Hall, from 10:30 A.M. to 4:30 P.M. The influence of the white man has created great changes in the customs of the Alaskan Eskimos; as a consequence, young Eskimos face a bewildering array of options as they try to integrate their traditional cultural values with new economic and social influences. The symposium will bring together anthropologists, filmmakers, a psychiatrist, an artist, and a photographer for a panel discussion of the issues that face Alaskan Eskimos today. The symposium is being presented jointly by the Museum's Education Department and the International Center of Photography, which is currently exhibiting Eskimo photographs by Alex Harris. Tickets for the all-day program cost $7.50 ($6.00 for members of the Museum and of the International Center of Photography) and can be obtained only through the International Center of Photography, Fifth Avenue and 94th Street. Call (212) 860-1776 for information on ticket availability.

The Universe and Dr. Einstein

A new sky show, *The Incredible Universe of Albert Einstein*, is opening at the Hayden Planetarium on March 4. Human understanding of the cosmos has undergone many changes, from the theories of Copernicus, Galileo, and Newton to those of Albert Einstein, and the new show explores Einstein's theories of the universe, including such topics as space-time, black holes, the relation between energy and mass, and the big bang. This sky show was made possible by a grant from the Joseph H. Hazen Foundation.

Courses for Stargazers

The spring semester of courses at the Hayden Planetarium begins in April, and advance registration is requested. Courses in astronomy, astrophotography, telescope assembly and use, aviation, navigation, and meteorology, as well as a number of courses for young people, will be given.

Garifuna Dance

A program of Afro-Carib music and dance will be presented by the Education Department on Wednesday, March 31, at 8:00 P.M. in the Auditorium. The *Garifuna Folk Dance Ensemble* will present dances that can be traced to the Garifuna people of Central America, who are part Arawak-speaking Indian and part West African. This program is free.

Galápagos Islands Cruise and Indonesian Odyssey

Places are still open on the Museum's cruise to the Galápagos Islands and the highlands of Ecuador, June 5 to 17, 1982. Three Museum curators will take a small group on a tour of the Galápagos Islands, noted for an abundance and diversity of life forms. The wildlife of the Galápagos greatly influenced Charles Darwin and provided evidence for his theory of natural selection.

The second Museum Discovery Tour to Indonesia in 1982 is completely booked, but a third will be offered in 1983. This unusual tour will focus especially on areas where the Museum has sent expeditions in the past. Among the places of interest the cruise will visit is Komodo Island, stopping place for the 1926 W. Douglas Burden Expedition, which brought back the first Komodo dragon, and islands where Margaret Mead worked in the 1930s. Lecturers from the Museum who will accompany the cruise are Thomas D. Nicholson, director of the Museum; Martin Prinz, chairman of the Department of Mineral Sciences; David Hurst Thomas, chairman of the Department of Anthropology; and four other scientists and curators.

The Museum offers other tours to unusual areas of the world. For more information, call Discovery Tours at the number listed below.

Sexual Encounters of the Floral Kind

Filmmaker John Cook, formerly a curator at the Museum, traveled around the world documenting unusual modes of pollination in plants. On Wednesday, March 3, at 7:30 P.M. in the Auditorium, he will show his film, *Sexual Encounters of the* when he was still an amateur, Zimmerman won fifteen bicycles, fifteen diamonds, one city lot, fourteen medals, seven pairs of studs, eight watches, six clocks, two wagons, one piano, two bronze sculptures, nine pieces of silverware, and more.

Champions of American Sport will be on display until June 27. It was organized by the National Portrait Gallery of the Smithsonian Institution and is sponsored by a generous grant from Philip Morris Inc.

Douglas J. Preston

Floral Kind, and answer questions from the audience. This free program is open only to members of the Museum.

Workshops for Young People

This spring, the Museum's Department of Education will once again offer a series of Workshops for Young People, to be held on weekends beginning April 17. *Exploring with the Microscope* and *Understanding Animal Behavior* are back, among other courses, and there are two new offerings: *Birding for Beginners*, in which parents are invited to enroll along with their children, and *Nature Crafts.* All courses are taught by Museum staff members and serve as introductions for youngsters new to the Museum or as supplements for experienced young museumgoers. Advance registration is required.

The World of Animals

Wildlife lecturer Bill Robinson will bring a ten-foot python, an armadillo, and other unusual animals to illustrate the way animals adapt for survival. The program, *World of Animals*, is free to members and $2.00 for nonmembers and will take place on Sunday, March 28, at 11:00 A.M. and 1:30 and 3:30 P.M. in the Education Hall. Advance tickets are required and can be obtained from the Membership Office.

Scientists in the Field

Three scientists from the Museum—Malcolm McKenna, Judith Winston, and Charles J. Cole—will show slides and talk about their unusual research activities in the field. This free program is open only to members and will take place on Wednesday, March 24, at 7:30 P.M. in the Auditorium. Advance tickets are required from the Membership Office.

For more information about programs listed in this section, call the appropriate department: Education Department (212) 873-1300; Membership Department 873-1327; Hayden Planetarium 873-1300; Discovery Tours 873-1440. Or write to the department at the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024.

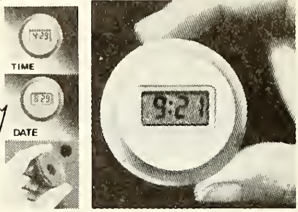
FINAL SALE! NOW JUST $4.88 SAVE MORE! 2 for $8.99 SAVE OVER $15. THOUSANDS OF THESE SUPERB CLOCKS SOLD AT $20.00

FANTASTIC Sticks-Up Everywhere Calendar Clock

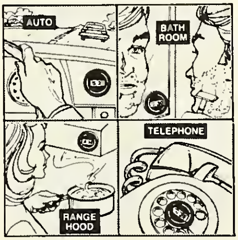
Displays hour and minutes with quartz crystal accuracy—changes automatically every 2 seconds to show month & date!

- NO WINDING! NO PLUGS! NO BUTTONS TO PUSH!
- SPACE-AGE ACCURACY!
- BUILT-IN COMPUTER adjusts for long and short months!
- EASILY REPLACEABLE BATTERY (included) powers clock for one FULL YEAR!
- SUPER-STICK, DETACHABLE FELT BACKING grips instantly to any surface, lets you STICK 'EM UP ANYWHERE!
- CHOOSE FROM 3 DECORATOR COLORS—red, yellow or beige!

AMAZING
- 1½" DIAMETER
- ½" THICK
- ½ OUNCE WEIGHT



Use 'em everywhere to keep you on schedule.
·TV set · attache case · refrigerator · desk · boat



NOT ~~$19.95~~
NOT ~~$14.95~~
NOW JUST $4.88 SAVE MORE! 2 for $8.99

SATISFACTION GUARANTEED! MAIL COUPON TODAY

OLD VILLAGE SHOP, Dept. VZ-776D
34D Poplar Street, Hanover, PA 17331

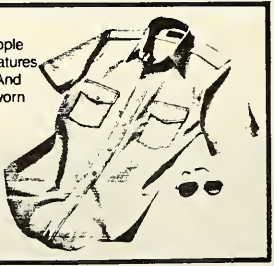
☐ **YES!** Please send me one STICK 'EM UP CALENDAR CLOCK #Z530105B for ONLY $4.88 plus $1.5D post. & hdlg.
Color choice: ____________
☐ **SAVE!** Send me 2 CALENDAR CLOCKS for ONLY $8.99 plus $2.75 post. & hdlg.
Color choices: ____________
☐ **SAVE MORE!** Send me 3 CALENDAR CLOCKS for ONLY $12.99 plus $3.75 post. & hdlg.
Color choices: ____________
Enclosed is $____________ (PA res. add sales tax.)
CHARGE TO: ☐ American Express ☐ VISA ☐ Carte Blanche ☐ Diners Club ☐ MasterCard
Acct. # ____________ Exp. Date ______
PRINT NAME ____________
ADDRESS ____________
CITY ____________ STATE ________ ZIP ______
Our policy is to process all orders promptly. Credit card orders are processed upon credit approval. Delays notified promptly. Delivery guaranteed within sixty days.
© H.H.I. 1982

OLD VILLAGE SHOP, Hanover, PA 17331

The Aviator Shirt.

Authentic. Manufactured by Van Heusen—the people who supply most of America's leading airlines. Features button-through flap pockets, one with pencil slot. And epaulets, naturally. Collar looks neat and correct worn open or with tie. Extra-long tail. This special edition Van Heusen shirt is cut for comfortable fit, and smartly tailored of military-weight poplin. The 65% Dacron* polyester/35% combed cotton fabric delivers the comfort you want plus the permanent press convenience you demand. Choose khaki, blue or white. Short sleeves $17. Long sleeves $18.

* DuPont registered trademark



Size Chart for the Aviator Shirt

Neck Size	14½	15, 15½, 16, 16½, 17	17½
Sleeve Length	Med (32/33)	Med (32/33) or Long (34/35)	Long (34/35)
When ordering indicate sleeve length by using letters M or L			

Neck sizes for short sleeve shirts 14½ to 17½

LONG SLEEVE @ $18

Qty	Color	Neck Size	Sleeve Length M or L
	White (19-567X)		
	Blue (19-568X)		
	Khaki (19-569X)		

SHORT SLEEVE @ $17

Qty	Color	Neck Size
	White (19-560X)	
	Blue (19-561X)	
	Khaki (19-562X)	

☐ **Please send free catalog**

Add $2.50 per order for shipping and handling, plus local taxes where applicable.
Make checks payable to Baker Street Shirtmakers
Mail your order...or call toll free (800) 528-6050

☐ Personal Check or Money Order ☐ Visa ☐ American Express ☐ MasterCard
Card # ____________ Exp Month ________ Year ________
☐ Mr. ☐ Mrs. ☐ Ms. ____________
Address ____________
City ____________ State ________ Zip ________

Baker Street® Shirtmakers
Creators of classic shirts at affordable prices
281 Centennial Avenue, Piscataway, New Jersey 08854
BFH

Celestial Events

by Thomas D. Nicholson

The Moon March begins with a five-day-old waxing crescent moon lighting the early evening sky. The reddish star to its left on the 1st and to its right on the 2nd, when it becomes a first-quarter moon, is Aldebaran, in Taurus. The waxing gibbous moon of the 4th and 5th is moving through Gemini (below the twin stars Castor and Pollux). Passing Regulus, the bright star in Leo, on the 7th and 8th, the moon, still in Leo south of Denebola, is full on the 9th. The waning moon then rises later nightly, near Spica, in Virgo, and the three nearby bright planets (Mars, Jupiter, and Saturn) from the 10th to the 13th. Last-quarter moon is above the "teapot" in Sagittarius on March 17. After new moon on the 25th, begin looking in the evening twilight sky for the crescent of the new cycle on the 28th and 29th. Next first-quarter moon is on March 31, full moon on April 8, and last-quarter on April 16.

Stars and Planets Except on the last day of the month, when Mars is in opposition from the sun, *all* the planets are morning stars in March. Mars, Jupiter, and Saturn are well placed for most of the night all month. Venus, although not at its best, should be very easy to find because of its brightness; it is low in the east at dawn. Mercury, although going through a long and well-separated (from the sun) morning elongation, rises too late and stays too low to be seen.

Don't fail to look for Mars, Jupiter, and Saturn, however, putting on a show even better than those of last summer and fall. A few hours after dark each evening, they are stretched out in line from the eastern horizon upward, with Spica among them. Mars rises first soon after dark, Saturn and Spica follow within an hour, and Jupiter rises about two hours later. During the night they swing upward to the right and then curve down again toward the west as dawn approaches.

No matter when or where you see them during the night, the brightest is Jupiter, Mars is next, and Spica and Saturn (with Spica below the planet) are a poor third, located between the two brighter planets. This month, it's Saturn playing tag with Spica (Jupiter played the game last year). Right now, Saturn is barely to the right (west) of the star, moving slowly away from it because the planet is in the retrograde phase of its motion. But Saturn will move back next summer to pass Spica again from right to left in September. Mars is also putting on one of its classical opposition shows, brightening very rapidly this month, then dimming just as rapidly in April, as it closes swiftly with the earth and then just as swiftly separates. It doesn't brighten as much during this opposition, however, as when the opposition occurs in early autumn, in a more favorable part of its orbit. At the better oppositions, Mars can become brighter than Jupiter.

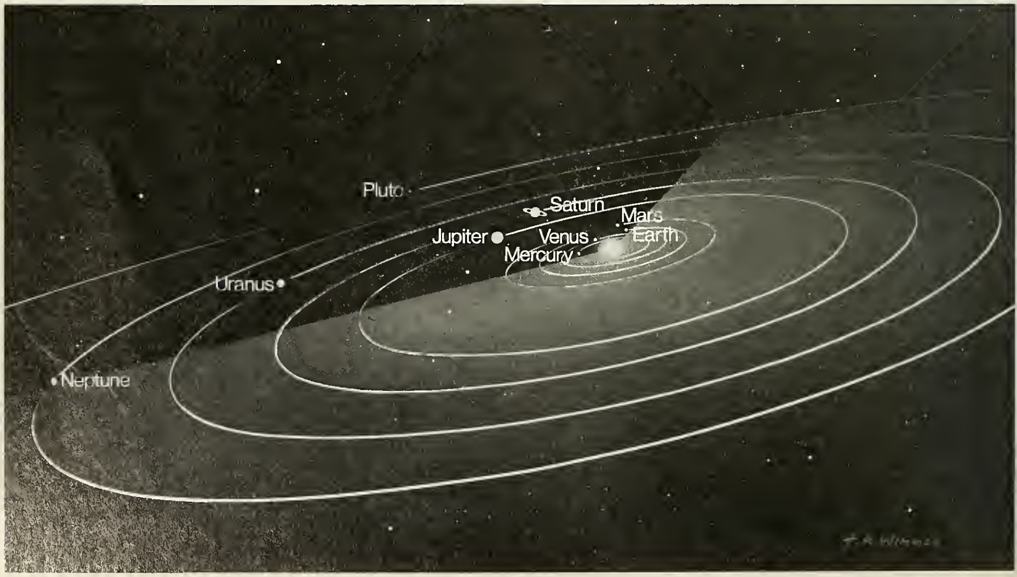
March 4: The moon is at perigee, nearest the earth.

March 10: Look at the moon tonight and see Mars, Saturn and Spica, and Jupiter extending out in line to its left (east).

March 11: The gibbous moon is between Mars (to the right) and Saturn (to the left) this evening. Spica is below Saturn.

March 12: The bright object to the moon's left is Jupiter, with Saturn, Spica, and Mars farther away to the right. Watch the moon carefully for only a half hour or so, and you can easily see its motion to the left, relative to the bright, nearby planets.

March 14: The moon trails behind Jupiter tonight as the planets parade up the eastern sky a few hours after sunset.



Helmut Wimmer

March 17: The moon is at apogee, farthest from the earth.

March 20: The sun arrives at the vernal equinox today at 5:56 P.M., EST, and spring begins in the Northern Hemisphere.

March 21: The waning crescent moon and Venus make a pretty pair in the dawn sky this morning.

March 29: The moon is at perigee again.

March 31: Mars is at opposition from the sun, rising at sundown, setting at sunrise. It now becomes an evening star.

April 1: Venus is at greatest elongation (westerly) in the morning sky. Now at its greatest distance to the sun's right, it is best placed for viewing as a morning star during this cycle. Unfortunately this is not a favorable elongation, the planet remains too low in the sky, but its brightness helps out.

April 5: Mars is closest to the earth during this cycle of configurations (95,010,000 kilometers, or 59,001,210 miles, distant).

April 7–10: The moon again joins the company of Mars, Saturn, and Jupiter in our sky.

April 8: Saturn, at opposition, enters the evening sky.

April 11: Mercury, at inferior conjunction, enters the evening sky.

Editor's Note: The Sky Map in the January issue shows the evening constellations and stars for this month and gives the times for use.

Exaggerated rumors about a close alignment of planets in 1982 and the possible effects of such an event have been circulated for years. It is not uncommon for all the planets to be on the same side of the sun, but there is no reason to believe the phenomenon would have noticeable effects on the earth. The closest gathering of planets in the 1980s occurs this month on the 10th, when all the planets will be located within an arc of about 98 degrees, measured from the sun, as shown at left. We will not see anything better than this for the rest of the twentieth century.

If you'd like a booklet explaining how we smooth out Jack Daniel's with charcoal, just drop us a line.

ASK THE ROGERS TWINS how Jack Daniel's Whiskey gains smoothness, and the reply will be identical.

Either Ray or Clay, who guide visitors here, will take you to a room where just-made whiskey is seeped through vats of tightly packed charcoal. And they'll point out how we've insisted on this whiskey-smoothing method since 1866. Of course, you may have trouble telling Ray from Clay. But if you compare Jack Daniel's to any other whiskey, you'll spot the difference in just a sip.

CHARCOAL MELLOWED
◊
DROP
◊
BY DROP

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery
Lem Motlow, Prop., Inc., Route 1, Lynchburg (Pop. 361), Tennessee 37352
Placed in the National Register of Historic Places by the United States Government.

NAHMAKANTA LAKE WILDERNESS LOG CABINS are one of the last few remaining wilderness areas left in Maine. We are the only camps on a large lake near Mt. Katahdin. From your camp porches you can see loons, ospreys, moose, deer and a vast variety of birds & waterfowl. We have trails to many remote ponds where we have canoes for exploring or fishing. Nahmakanta has long been noted as one of Maine's most beautiful lakes. An ideal spot for birders & nature lovers. Since 1865. Guests are served from our garden daily. No public roads, phones, or T.V.'s. For color brochure write: Paul & Fran Nevel, Box N-85 Andover, ME 04216 or talk with us at: (207) 392-2222 until May 1st

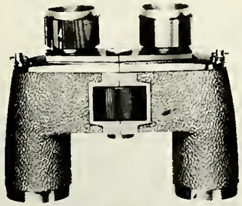
CHINA

GREAT CHINA INTERNATION TOURS

CHINA TOUR™

大中國際旅遊公司

SUPER SAVER
(212) 233-1000



BUSHNELL 7x35 CUSTOM

Mfg. List $280.00 **Postpaid $164.00**

This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

WHEN YOU WRITE TO NATURAL HISTORY

about a subscription renewal, billing, or any kind of adjustment, please include your present address label.

Moving? Please notify 6 weeks in advance. Send your present address label along with your new address to Natural History Membership Services, Box 4300, Bergenfield, NJ 07621

Name ______________________

New Address ______________________

____

City ________ State ________ ZIP ________

Please Print Attach Label

Additional Reading

Lichens (p. 30)

M.E. Hall's *The Biology of Lichens* (New York: American Elsevier Publishing Co., 1974) is an excellent general discussion on most aspects of lichens—their morphology, reproduction, physiology, symbiosis, ecology, classification, systematics, and economic uses and applications. *The Lichens*, edited by V. Ahmadjian and M.E. Hale (New York: Academic Press, 1974), a standard reference on the subject, is a collection of articles tailored for advanced students and professionals. *How to Know the Lichens*, by M.E. Hale (Dubuque: William C. Brown Co., 1979, second edition), a manual to the macrolichens of the United States and adjacent Canada, has many keys and illustrations. For a detailed account of the chemical compounds produced by lichens, see C.F. Culberson's *Chemical and Botanical Guide to Lichen Products* (Chapel Hill: University of North Carolina Press, 1969). V. Ahmadjian's *The Lichen Symbiosis* (Waltham: Blaisdell Publishing Co., 1967) provides a detailed treatment of experimental aspects of lichens: how to isolate and culture lichen symbionts, lichen physiology, and lichen synthesis.

Mauritius Birds (p. 38)

Extinct and Vanishing Birds of the World, by J.C. Greenway, Jr. (New York: Dover Books, 1967, revised edition), gives accounts of extinct and vanishing forms, describes the threatened birds of Mauritius, such as the ring-necked parakeet, and also covers Mauritian birds known only from descriptions, drawings, or a few bones or remains. Written and illustrated by T. Halliday, *Vanishing Birds* (New York: Holt, Rinehart and Winston, 1978), a study of natural history and conservation, discusses the Mauritian kestrel and ring-necked parakeet and also details the histories of several extinct species, including the dodo. The International Council for Bird Preservation's red data book, *Endangered Birds of the World*, by W.B. King, has recently been published (Washington, D.C.: Smithsonian Institution Press, 1981). F. Staub's *Birds of the Mascarenes and Saint Brandon* (Port Louis, Mauritius: Organisation Normale des Enterprises, 1970) is difficult to obtain, but it is the only work on the subject.

Mountain Gorillas (p. 48)

G.H. Bourne and M. Cohen's *The Gentle Giants* (New York: G.P. Putnam's Sons, 1975) pieces together early accounts of gorillas from hunters and from studies in the wild and in captivity, especially at the Yerkes Primate Research Center. What emerges is a portrait of the gorilla as "a wonderful and noble nonhuman primate" and "gentle vegetarian." In 1967 D. Fossey left her job as an occupational therapist in California and, supported by the National

Peter G. Veit

Geographic Society, set up camp in the Virunga volcanoes region, where she began her close-range study of gorillas in their natural habitat. Fossey wrote a series of interesting articles for *National Geographic* in which she recounts her life among gorillas and describes gorilla society: see "Making Friends With Mountain Gorillas" (January 1970, pp. 48–67), "More Years With Mountain Gorillas" (October 1971, pp. 574–85), and "Life Among Mountain Gorillas" (April 1981, pp. 501–23). G.B. Schaller's *The Mountain Gorilla* (Chicago: University of Chicago Press, 1963), a report on the author's 1959–61 expedition to study this animal, gives a detailed account of its ecology and behavior in its natural environment. Schaller surveyed mountain gorilla range in the eastern Congo, Rwanda-Urundi, and western Uganda, with special emphasis on distribution and ecological diversity. To observe the life history of the mountain gorilla in one location, Schaller and his wife spent a year studying a population in the Virunga volcanoes of Albert National Park, Congo. See also Schaller's *The Year of the Gorilla* (Chicago: University of Chicago Press, 1964).

Soufrière Volcano (p. 60)

After ten months of mild premonitory activity, Soufrière volcano erupted on April 13, 1979. "The Eruption of Soufrière Volcano," by J.B. Shepherd et al. (*Nature*, vol. 282, pp. 24–28), reports on this explosion, covering its early stages, pyroclastic flows, subsequent explosive activity, the crater during the eruption, and seismological observations. "Eruption of Soufrière Volcano on St. Vincent Island, 1971–72," by W.P. Aspinall, H. Sigurdsson, and J.B. Shepherd (*Science*, vol. 181, pp. 117–24), investigates Soufrière's renewed activity, which began in late 1971, reviews its historic eruptions, and suggests that the volcano erupts in a two-stage, alternating cycle. *Volcanic Activity and Human Ecology*, edited by P.D. Sheets and D.K. Grayson (New York: Academic Press, 1979), is an interdisciplinary collection of articles focusing on the effects of volcanism—its beneficial and destructive results—on human populations. This work also provides a thorough introduction to the geology of volcanoes.

Rita Campon

EXPLORATION CRUISES
FOUR NEW CRUISE ITINERARIES FOR 1982; EACH ONE A UNIQUE AND MEMORABLE EXPERIENCE!

Sacramento and San Joaquin Rivers. From $399. Depart San Francisco, 3 nights. All-new itinerary! Follow the San Joaquin and Sacramento Rivers along the historic Sternwheeler Route through scenic Delta Country to Stockton and Sacramento. Relax aboard ship, visit museums, vineyards, quaint villages and cosmopolitan San Francisco.

Majestic Alaska. From $1197. Depart Ketchikan, 7 nights. This extraordinary cruise originates within Alaska, so more days are spent in the spectacular Inside Passage. Aboard the new MAJESTIC ALASKA EXPLORER, you'll visit more ports and scenic areas than any other ship during a full week's cruise.

Canadian and Pacific Northwest. From $646. Depart Seattle, 4 or 5 nights. Cruise aboard the PACIFIC NORTHWEST EXPLORER to visit spectacular Princess Louisa Inlet, Canada's Gulf Islands, Victoria and Vancouver B.C., and Washington State's beautiful San Juan Islands.

Columbia and Snake Rivers. From $1197. Depart Portland, Oregon, 7 nights. Follow the trail of Lewis and Clark, inland to Lewiston, Idaho and Hell's Canyon. Cruise 900 miles of the Columbia, Willamette and Snake Rivers, through the nation's most extensive lock and dam system, aboard the new GREAT RIVERS EXPLORER.

MAIL THIS COUPON TODAY—PLAN EARLY FOR BEST SELECTION OF CABIN AND DEPARTURE DATE!

Please send me the following free Brochures:
☐ Sacramento and San Joaquin Rivers
☐ Canadian and Pacific Northwest
☐ Majestic Alaska
☐ Columbia and Snake Rivers

EXPLORATION CRUISE LINES™
1500 Metropolitan Park Bldg., Dept. NH-CC3
Olive Way at Boren Avenue, Seattle, WA 98101

NAME ________
ADDRESS ________
CITY ________ STATE ________ ZIP ________
A Division of Alaska Tour and Marketing Services, Inc.

Chinese delicacy.

Exquisite cinnabar egg makes an extraordinary accent piece or special gift. Careful layering of Chinese cinnabar lacquer, accentuated by delicate Oriental carvings, conveys a most exotic quality. Includes rosewood stand. 4" high. Your satisfaction is guaranteed through our Lloyd's of London correspondents. Just $33.50 (including postage), from Willoughby & Taylor Ltd., 5R0097, 2912 Iron Ridge Road, Dallas, Texas 75247. Cheque, money order or all major charge cards.

☐ YES! Please send me a complete catalogue of international treasures, free with my order. ($1.00 separately.)

Willoughby & Taylor Ltd.
International Merchants

For charge orders, call Toll-Free (800) 527-1885. In Texas, call collect (214) 634-4500.

Relax While Camping, Sketching, or...

with the Folding Hobby Seat from Brodhead-Garrett. Handcrafted from Real Oak, its contour design will give you years of comfort and beauty. And the compact size (only 14" high) makes it easy to carry and store.
30 day MONEY BACK GUARANTEE
Brodrick's Tool and Hobby catalog

Brodrick's
Dept 203
4560 East 71st St
Cleveland, Ohio 44105

ORDER TOLL FREE
800-321-6730
(in Ohio: 800-362-8915)

Please send ____ hobby seats at $24.50 each (ppd)
☐ Check, money order enclosed for $ ____
☐ Charge my ☐ Visa ☐ Master Card $ ____
Card # ____ exp ____
MC Bank # ____
NAME ____
ADDRESS ____
CITY ____
STATE/ZIP ____
☐ Please send FREE Color Catalog

Heavy Date

An afternoon at Indio's date gardens recalls an optimistic era for an exotic fruit

by Raymond Sokolov

If you don't play golf or tennis and you don't want to sit by a pool or visit a film star's desert *dacha*, there are only two nonalcoholic ways to pass the time in Palm Springs, California. One is to take the gondola lift up a cliff to a high mountain, from which vantage the overdeveloped desert below looks fairly untrammeled and you get a spectacularly chilling view of the San Andreas fault, clearly marked off by sands of distinctly differing browns stretching away on either side of the famous geologic boundary line. Radon seeping out of the ground at a menacingly high rate has recently encouraged experts to predict a major earthquake in the area. This news sent me zipping down a resort-clogged highway to see the region's other authentic attraction before it is overwhelmed by geophysical *force majeure.*

No tremors disturbed the tarmac of Highway No. 111 as I approached the city of Indio, America's date capital. Tall palms heavy with bunches of dates gave an exotic tone to the desert. Souvenir shops invited tourists to stock up on the "Arabian" berry with the grooved seed that put Indio on the map. In the spotless town itself, the fairgrounds looks like the set for the casbah in a silent-era Hollywood backlot epic, evoking more innocent times before the word *Arabian* was dated and when the Middle East was still a harmless, picturesque place famous mainly for Sheherazade, Sinbad, and T.E. Lawrence.

In Indio, eating date ice cream, surrounded by trees that were planted several decades ago at the dawn of the U.S. date industry, one momentarily manages to forget the mounting tensions of the Arab world. If time has not exactly stood still in Indio, this is nevertheless a place devoted to a fading moment in our history when California was still a pioneer state full of boundless optimism. The chief wonder of this sunny paradise was its unplumbed but obviously fabulous agricultural potential.

I am talking about the early years of this century, the springtime of the modern era in southern California, before serious in-migration turned the area into a megalopolis. A woman I knew, who was born in Covina in Los Angeles County just before World War I, used to boast that her birth certificate had a number with only three digits because so few people had been born there even by that relatively late date.

At about the same time, a band of far-seeing horticulturists and high-risk speculators decided to introduce useful plants from tropical countries to the almost embarrassingly hospitable soil of California (and other warm American states such as Florida). To this movement, led by the great botanist David Fairchild, we owe the avocado, the commercial citrus crop, and among many other delicious, nonnative fruits, the date.

Even without making the trip to Indio, reflective epicures will feel wistful when they contemplate the subsequent career of the date in these United States. Imported on shipboard and then brought to the southwestern deserts in the 1890s, date palms took root, flourished, and spawned a hopeful industry that somehow never won the vast and steady following its propagators fondly planned and plotted as they waited for their palms to mature and fruit. Today, dates are still a specialty crop. As a nation, we consume only a few thousand tons a year. Americans have never developed much of a taste for them. I found that I could barely give away dates to most of the people at my hotel in Palm Springs. And these were not just any old dates. They were jumbo, unsulfured royal medjool dates fresh from the tree.

Rebuffed, I felt a rush of sympathy for the Indio date growers, who must fight such philistine indifference every day. Back in the beginning of the Indio date gardens, evangelizing on behalf of their dates must have been a positive pleasure for the growers. But decades later, their mission has largely failed to make the date an American staple, and

Authentic
AUDUBON BIRD CALL
Beautifully handcrafted of Birch & Pewter. Just twist & a variety of wild birds answer. The perfect companion for nature lovers of all ages. **$5 ea. or 2 for $9 postpaid.**
Send check or m.o. TODAY to
Animals & Company
LONG RIDGE RD., W. REDDING, CT 06896

Wildlife Tours
Wildlife safaris Tanzania, Kenya, Botswana
Gorilla viewing Rwanda
Andes, Amazon and Galapagos islands
many other trips
Travel with the experts
Adventures International
4421-N Albert St., Oakland, CA
(415) 531-6564

Natural History
Nice'n Neat
Slip your **Natural History** issues into permanent files for ready reference. Green leather-like face embossed in gold to look like fine books. It holds one year's subscription. Also for **Smithsonian**, blue, 1 year. **Audubon**, green, 1 year. **Scientific American**, red, 1 year. **National Wildlife**, blue, holds 3 years. Specify title and quantity. Postpaid.
$5.20 ea. $4.63 ea., 3 or more.
Send check or Master Charge or VISA number with exp. date, signature to
Highsmith
P.O. Box NAT 25 Ft. Atkinson WI 53538
Catalog of files free with order

We repeat our enormously popular and successful exploration of Western Australia:
The Last Frontier
OCTOBER 9 TO 30, 1982
This tour, designed for people who enjoy unique flora and fauna, includes visits to the vast karri and jarrah forests in the south, the subtropical Kimberley Range with its aboriginal cave paintings in the north, Broome with its magnificent beach on the warm Indian Ocean, and a three-day stay at remote Nyang Station Homestead where we participate in the ranch activities.
Accommodations are at the most luxurious hotel in Perth, simple inns in the outback, and under canvas on an island in Lake Argyle and on the stark Abrolhos Islands.
Detailed brochures of the tour and a copy of our newsletter which lists all our fascinating travel programs, available from:
HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

to visit the gardens and endure the sales pitch concocted in a simpler, more optimistic era is a chastening experience. For the full treatment, the peripatetic fruit historian stops at Shields Date Garden, an Indio landmark since 1924 when E. Floyd Shields and his wife, Bess, first took possession of a few trees imported from Algeria. By 1977, they had expanded their garden to some 1,200 trees and had also developed a variety of schemes for packaging, shipping, promoting, and dramatizing their luscious fruit.

Shields Garden has not only trees and a retail store but also a date theater, with 108 seats and a continuous audiovisual presentation. The big sign outside proclaims: See it Now. Romance and Sex Life of the Date. In Sound and Color. Irresistible. I bought a date milkshake, intense with date flavor because it was made from date crystals (coarsely ground dried dates), and went into the darkened auditorium.

It is easy to make the Shields show sound ridiculous. In the richly overmodulated tones of an announcer from the golden age of radio, the voice of the recorded narrator propounds the case for dates with all the sloganeering and cuteness of a commercial created at the dawn of broadcast advertising. With the modesty of a used-car salesman, he talks up the unique virtues of the hybrid Shields Black Beauty date, twenty-three years in development, so precious that each customer may purchase only one. These "blackest of black dates" are "red when they're green."

Sophisticated viewers may laugh at pictures of the late E.F. Shields, wearing a pith helmet and holding fluffy bunches of female and male date blossoms. But behind all the self-promotion and the preposterous joking about date sexuality is a remarkably detailed exposition of the facts of date horticulture. Even the most jaded visitor cannot fail to learn something about the strenuous symbiosis between human effort and date biology that eventually produces

KEEP A COOL HEAD

PLANTATION HAT
The hat made famous by riverboat gamblers and planters in the Old South. Cool and breathable cotton duck with genuine leather hatband. Broad, flexible brim shades face and neck from sun. **Color:** Cream. **Sizes:** S(6⅞-7), M(7⅛-7¼), L(7⅜-7½), XL(7⅝-7¾). **$16.95** postpaid.

PANAMA STRAW HAT
Roll it up for travel or storage—it springs back into shape when unpacked. Featherweight straw forms a cool, airy crown and brim that shades face and neck. **Color:** Natural. **Sizes:** S/M/L/XL. **$17.50** postpaid.

Order Today! Money Back Guarantee!

Here is my check or money order for $________
(Add sales tax for shipment into CA, CO, D.C., IL, MA, MI, MN, PA, WA).

☐ MC ☐ VISA ☐ AMEX
Card No.__________ Exp. Date________

☐ **#1954 Plantation Hat** Size__________

☐ **#1985 Panama Straw Hat** Size__________

☐ **Send me your FREE color catalog of quality outdoor apparel and equipment.**

Name ________
Address ________
City ________
State ________ Zip ________

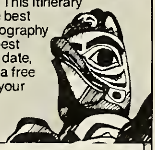
Stores throughout the U.S.

Eddie Bauer®

Dept. XNH, Fifth & Union, Seattle, WA 98124

ALASKA PHOTO SAFARI

The ultimate Alaska Experience! See and capture the Great Land, its scenic grandeur, colorful and diverse heritage, rich cultures and teeming wildlife. Visit the Arctic, Mt. McKinley, the exotic Pribilof Islands, Katmai, Glacier Bay and more. This itinerary is paced to provide the best opportunities for photography and observation. For best selection of departure date, reserve now. Write for a free color brochure or see your travel agent.



ALASKA
EXPLORATION
HOLIDAYS AND CRUISES
1500 Metropolitan Park Bldg. Dept. NH-PS3
Seattle, WA 98101

NAME
ADDRESS
CITY STATE ZIP
Division of Alaska Tour & Marketing Services, Inc.

Treasures From The Earth

Color Portfolio of Natural Specimens and Catalog of Minerals, Display Stands, Books and Natural Jewelry, $3.00

Dover Scientific
Box [illegible] Long Island City, NY [illegible]

For the sixth year, we offer a small group of adventurers a unique travel experience.

The Great White Bears

OCTOBER 14 TO 21, 1982

Each year in late October, hundreds of 1000 pound polar bears migrate towards the shore of Canada's vast Hudson Bay and wait there for the coming of the winter sea ice.

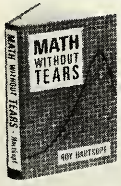
From our comfortable Churchill base we again make forays by tracked vehicle and helicopter to see and photograph the remarkable and stirring sight of these wild carnivores roaming free.

Detailed brochure and a copy of our newsletter which lists all our fascinating travel programs, available from:

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

BOOK HUNTING?
Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: BOOKS-ON-FILE
Box 195 Dept. 72
UNION CITY, NEW JERSEY 07087

More Birds in Your Yard
or your money back!
Thistle Seed Feeder attracts finches, chickadees, nuthatches. Send $11.50 PPD.
Easy-to-install
Write for FREE Catalog today.
Free 2 lb. Thistle Seed with each feeder.
The Bird Tree
5336 East Bald Eagle Blvd., Dept. 84
White Bear Lake, MN 55110



MATH WITHOUT TEARS
Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written.
Learn math in the comfort of your own home at minimum cost.
Order Now: $10.95 plus $1.25 hdlg.
EMERSON BOOKS, INC.
Dept 359-G, Verplanck, NY 10596
10 Day Money Back Guarantee

SAVE 33% WHEN YOU ASK FOR MORE ALASKA
Cruise the Inside Passage with TravAlaska and save up to 33% by choosing the economical Alaska Ferry. Or experience the luxury of a cruise ship or new mini-cruiser. And for the first time, you can choose a dollar-stretcher itinerary that shows you the Best of Alaska *and the Canadian Rockies* in one scenery-packed trip.
YOU CAN'T ASK FOR MORE ALASKA THAN TRAVALASKA
TravAlaska
TravAlaska Tours
Fourth & Battery Bldg., Suite 555
Seattle, WA 98121
Please send me your free brochure on Alaska and the Canadian Rockies NH3
Name ____
Address ____
City ____
State ____ Zip ____

the moist, rich dates on sale at the counter outside the theater.

Each tree sends out either male or female blooms. Shields employees bring the male pollen to the female flower. Climbing up the trees on fixed ladders, they "visit" each female tree twice a week during February, March, and April, searching for open blooms, which must be pollinated in the first three to four days after opening or they will dry up and mature inadequately.

Before pollination, the spathe, or outer covering of the bloom, is removed and the end of the bloom is pruned away. As the dates start to grow, the bunches have to be thinned and tied up to keep the stem from breaking under the weight of the fruit. Such careful management allows a tree to produce fruit of good quality from year to year, without depleting its energies.

Even without manual pollination, there would be enough pollen carried from tree to tree by the wind to insure the survival of the species. This is nature's way, but it isn't thorough enough to produce a serious bunch of dates on every tree. And in southern California, growers also have to irrigate their date gardens, with water brought in by the All-American Canal from the Colorado River 209 miles away. As a brochure on sale at the Shields Garden explains, "Date Palms get thirsty about every week or ten days." They use as much water as a willow, and gardens have to be flooded periodically. Maturing fruit must also be covered with waterproof bagging to protect dates from rain damage in August and later in the year.

The picking season starts in September and runs through Christmas. Afterward, the trees are cleaned up, old fruit stems cut off, and thorns removed from new leaves so that workers won't get pricked when they come to pollinate the blooms.

Dates will grow from seed, but this is not a good way to reproduce choice, productive strains. Vegetative propagation from the offshoots that each tree sends out is the preferred method, even though it takes several years before an offshoot can be cut away and rooted on its own, and then it will not come into fruit production for another eight to fifteen years.

Obviously, the entire arduous process of date farming is a costly and difficult business. Not everyone who plunged into it zealously before World War II is bothering to continue. According to the Shields brochure, "Many of the date growers are digging out their beautiful date gardens in spite of the fact that the palms are right in their prime, because they are not receiving enough for their dates to pay the cost of production."

When I was in Indio last October, at the height of the season, jumbo medjools were selling for just over $4 a pound at the Shields store, which seemed reasonable for such superb fruit. An even greater variety of dates, at a somewhat lower price, was available at Albert's Ranch Market in Banning, on the way back to Los Angeles. Not only medjools but also deglet noors, halawys, soft honey dates, zahidis, and my favorite, barhi honeyballs literally dripping with sweetness.

You will have no trouble locating Albert's. It is a big red barn just off the freeway with a large statue of a hen in the parking lot and a sign advertising Cackle Fresh Eggs from Our Hens. Inside they are selling the bounty of the earth, and posted by a water fountain is one of the country's great signs: Out of courtesy to other patrons. Drinking fountain only. Do not wash false teeth, hands or fruit here. Thanks Mgmt.

Raymond Sokolov's new book, Fading Feast *(Farrar Straus and Giroux), is a collection of food columns that first appeared in* Natural History.

Bess M. Shields's Date Pie

1 9-inch unbaked pie shell
1 cup sliced dates
½ cup chopped walnuts
⅓ cup melted butter
⅓ cup sugar
3 eggs, lightly beaten
¼ cup heavy cream
1 cup light corn syrup
1 teaspoon vanilla extract
⅛ teaspoon salt

1. Preheat oven to 275 degrees.
2. Cover bottom of pie shell with dates and walnuts.
3. Mix together all remaining ingredients in a bowl and pour over dates and walnuts.
4. Bake for one hour.

Yield: 8 servings

Date Milkshake

Combine the following in a blender.

2 tablespoons date crystals dissolved in a little milk
3 tablespoons vanilla ice cream
¾ cup cold milk

Yield: 1 serving

Imported by The Paddington Corporation, New York, N.Y. 34 Proof © 1981

WHAT'S A SPECIAL EVENING WITHOUT A LITTLE MAGIC?

BAILEYS
ORIGINAL IRISH CREAM
THE ORIGINAL IRISH CREAM
BAILEYS
ORIGINAL IRISH CREAM
THE ORIGINAL IRISH CREAM LIQUEUR

Baileys. A unique taste so silken, so full of character, only one word can describe it. Magic.

Perhaps it's that taste of magic that has made Baileys America's fastest growing liqueur.

BAILEYS. TASTE THE MAGIC.

THE ART OF ILLUMINATION.

PROBABLY THE BEST investment you'll ever make in decorating your home. It's the same handmade Waterford crystal that now hangs in such famous places as Westminster Abbey and Kennedy Center. Not only does it illuminate your home, a Waterford lamp or chandelier transforms it.

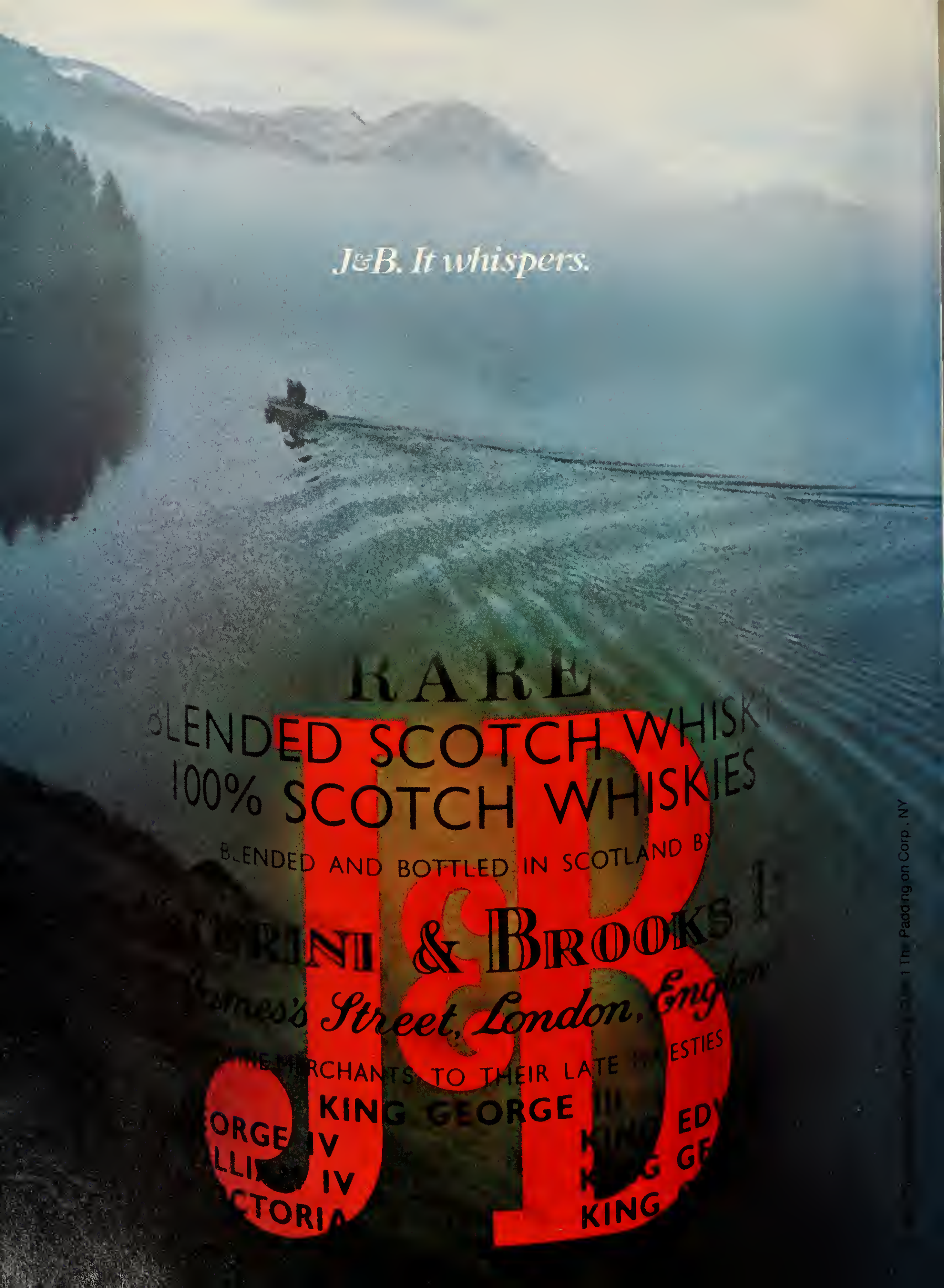
WATERFORD®

Be sure it's authentic Waterford,
handmade only in Ireland.
Illustrated booklet, Waterford Crystal
225 Fifth Avenue, NY 10010

NATURAL HISTORY

$2

4/82


J&B. It whispers.
RARE
BLENDED SCOTCH WHISK
100% SCOTCH WHISKIES
BLENDED AND BOTTLED IN SCOTLAND BY
RINI & BROOKS
mes's Street, London, Engl
MERCHANTS TO THEIR LATE ESTIES
KING GEORGE III
ORGE IV
LLI IV
TORIA
KING ED
KING GE
KING
J&B

[illegible] 1 The Paddington Corp., NY

NATURAL HISTORY

Vol. 91, No. 4, April 1982

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director

Alan Ternes, Editor
Judith Friedman, Managing Editor
Thomas Page, Designer
Board of Editors: Carol Breslin,
Sally Lindsay, Frederick Hartmann,
Vittorio Maestro, Rebecca B. Finnell
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
E. Kay Danzig, Art Asst.
Kay Zakariasen, Picture Editor
Douglas J. Preston, Publications Editor
Annie R.C. Finch, Editorial Asst.
Lillian Berger
Editorial Advisers:
Malcolm Arth, James W. Atz,
Niles Eldredge, Kenneth L. Franklin,
E.Craig Morris, Norman Newell,
Thomas D. Nicholson, Martin Prinz,
Gerard Piel, Nina Root

David D. Ryus, Publisher
Bradford D. Smith, Business Manager
Frederick E. Grossman, Production Mgr.
Debra Buck McCord, Asst. Production Mgr.
Ernestine Weindorf, Administrative Asst.
Elaine M. Callender, Advtg. Production Mgr.

Cary Castle, Circulation Manager
Jeff Pieper, Assoc. Circulation Mgr.
Ramôn E. Alvarez, Asst. Circulation Mgr.
Frank Stevens, Circulation Asst.

Natural History *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Subscriptions: $15.00 a year. In Canada and all other countries: $20.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.*

Copyright © 1982 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.*

Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225
Subscription Orders (800) 247-5470
(800) 532-1272 (in Iowa)

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

2 **Authors**

6 **Big Advantages of Small Refuges** *Daniel Simberloff*
Can we live rationally with our co-occupants on Earth?

16 **This View of Life** *Stephen Jay Gould*
The Importance of Trifles

24 **Squid Swarm** *Photographs by Jeff Foott*
A massed nighttime frenzy leads to procreation and death.

28 **Low and Slow, Mean and Clean** *William Gradante*
Will Oscar "Mad Hopper" Yânez ever break Ralph "Rag Top" Carrillo's record?

42 **Airborne Models and Flying Mimics** *Alexander W. Hiam*
Some tropical butterflies are tasty showcases of evolution.

50 **The Late, Great Sabertooths** *Leonard Radinsky and Sharon Emerson, illustrations by Douglas L. Cramer*
My, what big teeth you had and how well you used them!

58 **Books in Review** *Myron L. Cohen*
China Underground

62 **Sky Reporter** *Stephen P. Maran*
The Inconstant Sun

66 **Celestial Events** *Thomas D. Nicholson*

72 **At the American Museum**
Komodo Dragon

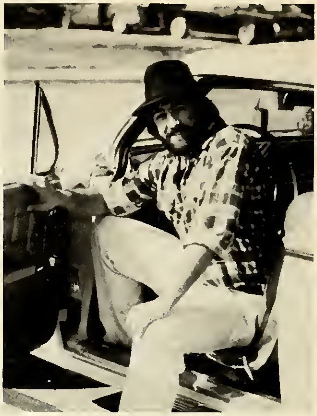
76 **Additional Reading**

78 **A Matter of Taste** *Raymond Sokolov*
Southern Comfort

Cover: *A goshawk feeds its chicks on a nest in Wyoming. Food taken by these large birds of prey consists mainly of small mammals and birds. In the winter of 1917, intense predation by goshawks on the world's last population of heath hens, confined to a single reserve on Martha's Vineyard, contributed to the extinction of this New England grouse. Photograph by Jeff Foott. Story on page 6.*

Daniel Simberloff is a professor in the Department of Biological Science at Florida State University in Tallahassee. His research lies in the general area of evolutionary ecology and biogeography. Half of that activity consists of fieldwork, mostly on the interactions of insects and plants, especially oaks and mangroves, and the structuring of natural communities of insects. The other half of his research is more theoretical and concerns community ecology, statistical ecology, and island biogeography.

Alexander W. Hiam first encountered heliconiid butterflies while studying birds in Colombia and Trinidad. His interest stimulated by the complexity of their patterns of mimicry, he did further research on these beautiful insects during a stint as assistant curator in the Department of Entomology of Harvard's Museum of Comparative Zoology. Now a technology analyst in the Berkeley, California, office of the Policy Research Corporation, Hiam is currently concerned with the uses of genetic engineering in agriculture. He hopes to conduct fieldwork again on the impact of bird predation on the development of races of tropical butterflies.



William Gradante, a part-time professional performer of Mexican folk music, is a Ph.D. candidate at the Center for Intercultural Studies in Folklore and Ethnomusicology at the University of Texas, Austin. He also teaches music and folklore as artist-in-residence for the Fort Worth Independent School District. His students in Fort Worth first drew his attention to the importance of "low rider" activities in the Mexican-American community. The folklorist in him was impressed by the low riders' enthusiasm, seriousness, and positive community goals. Gradante is writing his dissertation on the modes of sociocultural expression in the folk festivals of San Juan and San Pedro, Colombia.

For the past fourteen years vertebrate paleontologist **Leonard Radinsky** has been professor of anatomy and evolutionary biology at the University of Chicago. He began studying carnivore skulls three years ago and concentrated on sabertooths because of their unusual skulls and because that specialization evolved several times independently. In the future Radinsky plans to study the evolution of horse skulls. The current article is his second for *Natural History* (see "Cerebral Clues," May 1976, on fossil braincases). When not working on skulls, Radinsky enjoys hiking in the mountains and collecting fossils in Wyoming.

Coauthor **Sharon Emerson** first saw sabertooth cat skulls when she visited the La Brea tar pits in Los Angeles as a student. Her interest in sabertooths was encouraged on reading about the natural history of living large felids and studying felids at the zoo. Emerson, whose other research has concentrated on understanding patterns of morphological diversity among frogs, is an assistant professor of biology at the University of Illinois at Chicago Circle and also teaches in the Women's Studies Program there. The two authors hope to collaborate again on functional analyses of ungulate feeding systems.

Your children will love them, too.

Children love animals—and there's never been a better or more enjoyable way for them to learn about animals than this wonderful new series of ZOOBOOKS! Now, the most important facts about the animals children love most have been put into a beautiful set of books that's available *at an astonishingly low price.*

Hundreds of superb color pictures make it easy for children to understand how animals look and behave—and *why* they look and behave as they do. Original paintings by leading wildlife artists are combined with some of the most striking animal photos ever published to get children excited and involved. These books *look* like fun—and they are!

Wildlife Education, Ltd.
Baby Animals
Sna
Big Cats
The Apes
Elephants

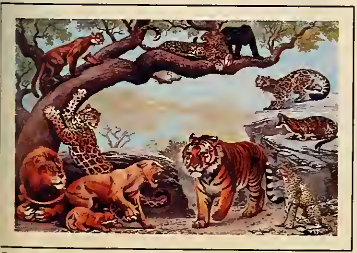
A simple, but scientifically accurate text makes it possible for even young readers to easily grasp the basic facts about each animal . . . as well as many other intriguing facts that most adults don't even know. (How many adults really know, for example, how a snake can move without legs? Or why a tiger would probably starve to death if it didn't have stripes?)

A complete library of richly illustrated books—for only $1 per book! Month after month, for a full year, a ZOOBOOKS subscription brings a wonderful parade of color-filled books: Bears, Apes, Big Cats, Elephants, Endangered Species, Wild Horses, Whales, Giraffes, Birds of Prey, Orangutans, Snakes, and Baby Animals. And you can subscribe to this marvelous set with *a complete guarantee that your children will love every book.* (See our guarantee on the coupon below.)

ONLY $1

PER BOOK

WHEN YOU SUBSCRIBE FOR 12 BOOKS



Actual Size—18" x 24"

FREE

When you enclose payment with your order, this magnificent full-color poster will be sent as part of the subscription. Suitable for framing, this unique work of art shows all the Big Cats and some of their most impressive relatives in wonderful detail. Regularly sold for $3.99, it's yours to keep, whether you decide to continue with the subscription or not.

SATISFACTION GUARANTEED. If you and your children are not completely satisfied with each and every book you receive, you may cancel your subscription at any time and receive **a full refund** on unshipped books. There's no risk, so subscribe today!

2008

Please send a full year of ZOOBOOKS® for only $1 per book (12 books for only $12) to:

NAME ____________________

(Please print clearly)

ADDRESS ____________________

CITY ____________________

STATE ____________ ZIP ____________

GIFT FROM ____________________

☐ **I enclose $12 payment. Please send a free poster as part of the subscription.**

☐ **Please bill me.**

Mail this coupon today to: **ZOOBOOKS**, 930 West Washington St., San Diego, CA 92103.

To collect . . . to enjoy . . . to display in your home . . .

The Antique Miniature Shaving Mug Collection

Bull Dog
SUSPENDERS
America, Bridgeport, Conn
ROW
ARS
New York
VICTOR
BICYCLES
NEW YO
& CO.
BRAND
RALLS
TRADE MARK
Watertown
H.H.
debaker
ARNESS
Mfg Co South Bend Ind

Twenty-five handsomely crafted barbershop mugs — created in our own time and issued in limited edition.

Available by direct subscription only.
Limit: One collection per subscriber.
Advance subscription deadline:
April 30, 1982.

THE OLD-FASHIONED SHAVING MUG—once an essential accessory for every American man—is looked upon today as a prized possession . . . sought out by collectors.

Especially desirable are the antique *barbershop mugs.* Handsomely decorated and masculine in feeling, they provide a nostalgic look back in time. Back to the more carefree days of turn-of-the-century America. When the neighborhood barbershop was a place to relax among friends. And where a man was "lathered up" for his daily shave from his own personal mug.

Now you can recapture that unique appeal of a bygone era with a remarkable collection of miniature antique shaving mugs—created in our own time by Franklin Porcelain. In a tradition dating back to the old-time barbershop era, these mugs will be richly decorated with the emblems and trademarks of products that were once part of a man's everyday life. And each of these designs will be an original work of art—created *exclusively* for this collection and fully authenticated.

Fascinating miniatures in an American tradition

The Antique Miniature Shaving Mug Collection will consist of 25 mugs depicting famous products from as many companies. Individually, each of these miniature shaving mugs will be a fascinating work to examine in detail. And, seen together, the complete collection will be even more appealing—forming a rich and colorful portrait of those marvelous days gone by.

Here, for example, is the suave Arrow Shirt Man in his high starched collar. The stubborn mascot of Bulldog Suspenders. The familiar "Strength of Gibraltar" slogan for Prudential Insurance. The newest in Studebaker harnesses. The colorful array of vegetables on the cover of a Ferry seed catalog. And a variety of other products catering to the masculine spirit—Buckingham's Whisker Dye, Winchester Rifles, the Locomobile "gasolene car," and Mennen's Talcum Powder.

In all, an authentic and impressive collection—recapturing a turn-of-the-century tradition in a uniquely American way.

Authentic in shape, in design . . . in every detail

To assure historical accuracy, the design for each shaving mug will be carried out to the specifications of the company that authorized its creation. Emblems, trademarks—even individual colors —will all be carefully authenticated and approved.

Each subscriber will receive a handsome hardwood case for display of all 25 miniature antique shaving mugs, as part of the collection.

These shaving mugs will be crafted in traditional earthenware for Franklin Porcelain in Brazil, and fired at high temperature to ensure the enduring beauty of the colors and designs.

Even the shapes of the mugs will vary throughout the collection, representing actual styles once used in barbershops all across the country. Thus, the sidecut of the base may be flared or coved; the handle curved, notched . . . or in the distinctive shape of a barber pole. Every detail completely authentic and true-to-scale—pleasing in proportion, inviting to the hand and eye.

Yet despite the care taken in designing and crafting the collection, the price for each shaving mug is just $12.50.

Wood display shelf provided at no added cost

In keeping with the time-honored tradition of displaying such uniquely decorated mugs to their full advantage, the collection will include a wood shelf designed to hold all 25 shaving mugs. Its rich dark finish provides the perfect background for these handsome mugs. And the display shelf will be sent to you as part of your collection—at no additional charge.

In addition, each shaving mug will be accompanied by a specially written commentary about the company—and the product—it represents. These commentaries will add to your enjoyment of the collection . . . recounting old advertising claims, product innovations, and how the companies changed and grew.

Issued in strictly limited edition

As a reminder of a way of life that once was, and of a manly tradition that has all but vanished today, this handsomely crafted collection will be admired by all who see it displayed in your home. And may well prove even more fascinating in future years . . . to future generations.

The Antique Miniature Shaving Mug Collection will be issued in just one edition, only by direct subscription, and only for a limited period of time. There is a further limit of one collection per person.

This opportunity to subscribe expires April 30, 1982, and the collection will be permanently withdrawn at the end of the year. The total edition, therefore, will be limited to the exact number of valid subscriptions entered by that date.

To subscribe now, mail the accompanying Advance Subscription Application by April 30th.

OUR PLEDGE TO YOU. We at Franklin Porcelain take pride in our high standards of craftsmanship. But we believe that our efforts should also be judged by the people we serve. You may therefore return any work in this collection for any reason within 30 days, in its original condition, for your choice of replacement or refund.

© 1982 FP

ADVANCE SUBSCRIPTION APPLICATION

The Antique Miniature Shaving Mug Collection

Valid only if postmarked by April 30, 1982.
Limit: One collection per subscriber.

Franklin Porcelain
Franklin Center, Pennsylvania 19091

Please enter my subscription for *The Antique Miniature Shaving Mug Collection,* consisting of 25 finely decorated miniature mugs. My shaving mugs will be sent to me at the rate of one per month.

I need send no money now. I will be billed $12.50* for each shaving mug in advance of its shipment. The custom-designed hardwood display shelf will be sent to me without additional charge.

**Plus my state sales tax and 75¢ for shipping and handling*

Signature ______________________
ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE.

Mr.
Mrs.
Miss______________________
PLEASE PRINT CLEARLY

Address ______________________

City ______________________

State, Zip______________________

ing mugs shown much smaller than actual 2½" height.

Big Advantages of Small Refuges

Few people question the value of wildlife refuges, but how to design them is a matter of debate

by Daniel Simberloff

The Puerto Rican parrot (*Amazona vittata*) resides only in the Luquillo Forest. At one time its numbers declined to thirteen, primarily because the U.S. Forest Service cut the sorts of trees that have the large holes required by the parrot for nesting. Contributing to the nesting-site shortage was the custom of chopping down trees to catch nestlings. The parrot's plight was exacerbated by pearly-eyed thrashers (*Margarops fuscatus*), which nest in similar tree holes and, if holes are sufficiently shallow, compete with the parrots during nest-site shortages by throwing out parrot eggs and commandeering the holes.

The parrot's extinction has been forestalled by an intensive management program, which includes deepening existing cavities (rendering them immune to thrashers) and constructing new ones, returning captive-bred birds to the forest, and encouraging thrashers to nest in nearby shallow cavities. Nesting thrashers exclude other thrashers from the vicinity of a nest, incidentally protecting adjacent parrots. Approximately twenty parrots now lead a tenuous existence in the wild, and there is hope that the species may recover.

Nevertheless, success stories, even one as tentative as this, are the exception rather than the rule. Furthermore, conservationists do not have the time or the resources to address the needs of each species threatened with extinction. At least one of the world's animal species or subspecies becomes extinct every year, and more than a thousand land and freshwater animal species and subspecies are officially classified as endangered. At least twenty thousand flowering plant species are estimated to be endangered.

Over periods of tens of thousands of years or more, all species are likely to become extinct or to evolve into different sorts of organisms, but this inevitable trickle of extinctions has greatly accelerated recently. The global rate of extinction in prehistoric times was scarcely one species every thousand years, even during such grim periods as when the great dinosaurs disappeared. In North America, one 3,000-year Pleistocene interval of particularly heavy extinction saw the disappearance of about fifty mammals and forty birds: three species per century. From 1600 to 1950, an average of one land or freshwater animal probably went extinct every ten years on a worldwide basis. The rate in North America has been proportionate: since the 1620 landing at Plymouth Rock, more than five hundred species and subspecies of plants and animals have been extinguished.

To staunch the flood of extinctions, people in the United States, and other nations, can do three things: change life styles, set aside effective refuges, and breed captive organisms. Most important is a whole battery of ways to live more rationally with respect to our co-occupants of the earth. Such rational living demands political action: for example, the enforcement of strong land-use and hunting laws, pollution controls, and strict limitations on introducing exotic species. The costs of these actions will seem increasingly onerous in an economically troubled time. Alleviating the threat of acid rain to lakes, for instance, will require a degree of international cooperation and expenditure on pollution control exceeding any current effort.

If a rational life style is the ultimate goal, refuges must be among its components. They also constitute the main immediate weapon against extinction. How to design them is a current controversy. Many more are needed, but how large should they be? What shape should they be? Where should they be located? How should they be arranged with respect to one another? Ecologists and conservationists recognize these as critical questions, but there is little agreement about answers, and surprisingly few data exist to serve as a guide.

In the past, conservation efforts in the United States tended to emphasize specific endangered species, and many refuges have been set aside to protect particular organisms: the California condor (*Gymnogyps californianus*), whooping crane (*Grus americana*), saguaro (*Carnegiea gigantea*), Kirtland's warbler (*Dendroica kirtlandii*), and Joshua tree (*Yucca brevifolia*), for example. The primary criterion for a successful refuge of this sort is suitable habitat for the target species.

Perhaps the firmest discovery of the young science of ecology is that each species has specific, and usually not very malleable, habitat requirements. Joseph Grinnell pioneered this concept, and although his notion of "ecological niche" has come to connote primarily a species' interactions with other species, he originally defined niche to mean those fundamental aspects of the physical environment (including vegetation for animals) that are absolutely required for a species' continued existence. Some important variables, such as temperature, are familiar: palms and mangroves do not grow in cold regions.

Subtler constraints also exist. The red-cockaded woodpecker (*Dendrocopus borealis*) is threatened in the southeastern United States because the old, dying longleaf (*Pinus palustris*) and loblolly (*P. taeda*) pines in which it nests are no longer allowed to grow old and die. Often they are replaced with faster growing, more valuable pulp trees. This

IN YOUR SEARCH FOR A LONGER LASTING CAR, REMEMBER LONGEVITY IS HEREDITARY.

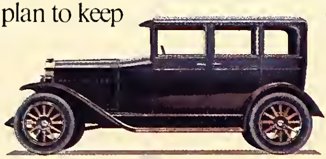
As car prices have spiralled, so have people’s expectations of what they should get for their money.

A recent study by the Roper organization, for instance, has shown that Americans plan to keep their cars longer.

Which could explain why more and more people are buying Volvos.

For 55 years, Volvo’s philosophy has been to produce durable, well-built automobiles. Nowhere is that philosophy better embodied than in the Volvos of today.

Recent findings show that Volvo’s life expectancy is 1/3 longer than the average life expectancy of all other cars on the road.*



So if you expect your next new car to last a long time, make sure you marry into the right family.

VOLVO
A car you can believe in.

---

*Analysis conducted by Ken Warwick & Associates, Inc. Based on a comparison of U.S. registration data for Volvo and for the automobile industry as a whole and not by individual make. Summary available at your Volvo Dealer. © 1981 Volvo of America Corporation.

woodpecker is threatened primarily by habitat alteration, the main force responsible for extinctions in the last three centuries.

Even broadly ranging species without specialized habitat requirements have quantifiable Grinnellian niches and can survive only within their bounds. Frances James of Florida State University and her coworkers have studied one of the commonest birds in the eastern deciduous forest, the wood thrush (*Hylocichla mustelina*), and found that canopy height and the number of shrubs and deciduous trees per unit area are most important in predicting where this species is found. If a refuge were to preserve the wood thrush, then, the first requirement would be appropriate habitat, just as for more geographically or ecologically restricted species.

The second criterion for any refuge would likely be its size. Population size is generally proportional to refuge size, and for long-term conservation, populations must exceed some minimum size that is characteristic for each species. The key reason populations must not be too small is a genetic one known as inbreeding depression. When small numbers of individuals constitute an entire breeding population, the probability is high that after a few generations mates are related. Such consanguineous matings tend to weaken the population. All individuals of diploid species carry a few genes that would cause death, sterility, or debilitation if they were expressed. Usually, in the offspring of unrelated parents, only one chromosome in a pair has a deleterious gene and the matching chromosome has the normal gene, which masks the harmful gene. Consequently, the individual appears normal. Since consanguineous matings are far more apt to produce offspring carrying deleterious genes on both, not just one, of the chromosomes in a pair, a much higher proportion of offspring from such matings are inviable, sterile, weak, or diseased. A common congenital diaphragm defect in the endangered Brazilian golden lion tamarin (*Leontopithecus rosalia*) appears to be such a genetic trait. Since only 197 individuals exist in captivity and perhaps 30 in nature, inbreeding has likely contributed to the frequency of this disease.

A more important problem with inbreeding is that, for reasons geneticists have yet to elucidate fully, the more genes for which an individual is heterozygous (has two different forms of a gene at the same spot on a chromosome), the more fertile on average it is likely to be and the more fit its offspring will be. This is true even if neither of the two different genes would be very deleterious if expressed. When inbreeding increases, as it does in small populations, heterozygosity drops, for the reason already given: an individual's parents are increasingly likely to be related, thus to share any given gene, and therefore to pass on the identical gene to offspring. So the population as a whole becomes less fecund and vigorous.

Although there is extensive evidence for such inbreeding depression in small populations of some laboratory animals and domestic stock, its effects on most populations confined to small refuges are inferred rather than demonstrated. Przewalski's wild horse (*Equus przewalskii*) probably no longer exists in the wild, and its captive populations, comprising about 300 individuals, are beginning to manifest inbreeding depression. Highly inbred individuals have fewer offspring, and the species suffers from more infant mortality, sterility, and hip weakness among mares. By contrast, captive populations of Père David's deer (*Elaphurus davidianus*) have in the last two centuries gone through at least two episodes of very small population size and consequent high inbreeding without apparent ill effects.

Nevertheless, a mass of information on domesticated animals and a recent survey of inbreeding effects on thirty-two species of primates and hoofed animals in zoos suggest that inbreeding depression would threaten any population confined to a very small refuge. Most workers agree that a population of at least fifty is required to counteract inbreeding depression, so if one refuge were to contain the entire population, it would have to be big enough for at least fifty individuals. Just how large this would be requires detailed knowledge of the species' ecology and social structure. The area required can be considerable. A pair of ivory-billed woodpeckers (*Campephilus principalis*), last seen in the United States in 1950, needs about 3,800 acres of undamaged bottomland forest; for large carnivores, food requirements and territorial behavior may well dictate even larger per capita areas.

There are other reasons, having to do with stochastic, or random, events, why viable populations cannot be too small. Because of chance fluctuations in predator, parasite, or pathogen populations or in habitat variables such as temperature, populations will sometimes suffer unusual mortality independently of individuals' genetic traits. The population must be large enough to survive such periods. Random demographic events—who gets to mate, how many offspring they have, and of what sex—are yet another consideration. For example, the possibility that all offspring in some generation will be males is much greater in a small population. Natural catastrophes such as fires and floods are also unpredictable and can be especially devastating to small populations.

Granted that a minimum population size must be maintained and that per capita area requirements necessitate a minimum area to conserve a target species, the question arises as to whether one large or several small refuges, with the same total area in each case, would be the wiser design. There is no consensus. The majority view, based on the desire to minimize inbreeding depression, has been that one large refuge is preferable. The contrasting opinion recommends separating populations of rare species into several isolated subpopulations (allowing for some migration between them), on grounds that this will increase heterozygosity and also vitiate the effects of stochasticity. In this view, much depends on how frequently individuals move between the smaller refuges to mate, hence helping to reduce inbreeding, but also possibly spreading contagious diseases. Population geneticists have shown mathematically that, depending on rates of migration, several small subpopulations are apt to persist much longer than one large population and also that heterozygosity in the population as a whole will likely be increased. Catastrophes and epizootic diseases would probably also be less damaging to a subdivided population than to a single large one because the disaster would not affect all individuals.

Examples of the dangers to single populations spring to mind. The heath hen (*Tympanuchus cupido cupido*) was once numerous in the Northeast, but populations dwindled as land was settled, until by 1870 fewer than 100 individuals were left, all on Martha's Vineyard. A refuge was created there in 1908 and a predator control program instituted; by 1916 the population neared 2,000 birds. A fire spread by a gale that year destroyed most of the habitat, and the next winter an unusually high density of goshawks (*Accipiter gentilis*) subjected the surviving heath hens to intense predation. Fewer than 150 individuals, mostly males, remained. By 1920 the population had climbed to 200, but blackhead, a disease of domestic fowl, killed more than half

BOOK-OF-THE-MONTH CLUB®

America's Bookstore® since 1926

Facts About Membership

As a member you will receive the *Book-of-the-Month Club News*® 15 times a year (about every 3½ weeks). Every issue reviews a Main Selection and 150 other books that we call Alternates, which are carefully chosen by our editors. If you want the Main Selection, do nothing. It will be shipped to you automatically. If you want one or more Alternates—or no book at all—indicate your decision on the Reply Form and return it by the specified date. *Return Privilege:* If the *News* is delayed and you receive the Main Selection without having had 10 days to notify us, you may return it for credit at our expense. *Cancellations:* Membership may be discontinued, either by you or the Club, at any time after you have purchased 4 additional books. Join today. With savings and choices like these, no wonder Book-of-the-Month Club is America's Bookstore.®

Book-of-the-Month Club, Inc., Camp Hill, Pennsylvania 17012

Please enroll me as a member of Book-of-the-Month Club and send me the set I have checked below, billing me for the appropriate amount, plus shipping and handling charges. I agree to buy 4 books during the next two years. A shipping and handling charge is added to each shipment. **A113-4**

Check one box only: ☐ 912. Compact OED **$19.95**

☐ 913. The Story of Civ. **$24.95**
☐ 917. Ency. of Philosophy **$19.95**
☐ 932. Beethoven (13 Records) **$15.95**
☐ 933. Beethoven (8 Cassettes) **$15.95**
☐ 934. Jefferson & His Time **$15**
☐ 947. Wildlife Series **$17.95**

Mr.
Mrs.______________________________ **2-61**
Miss (Please print plainly)

Address____________________ Apt.______

City____________________________

State____________________ Zip______

Prices shown are U.S. prices. Outside the U.S., prices are generally higher.

Place
Stamp
Here

BOOK-OF-THE-MONTH CLUB®
Camp Hill, Pennsylvania 17012

Choose one of these six sets and save up to $282.50.

You simply agree to buy 4 books within the next two years.

The Compact Edition of The Oxford English Dictionary

The "most complete, most scholarly dictionary of the English language"—*The Christian Science Monitor*. Through photo reduction, the original 13-volume set has been reproduced in this two-volume *Compact Edition*. Magnifying glass included.

$125.00	Publisher's price
-$105.05	Your savings
$ 19.95	Book-of-the-Month Club price

Wildlife Habitat Series

Six volumes from the award-winning series: wildlife of the polar regions, forests, islands, prairies and plains, rivers and deserts. More than 200 color photographs in each volume, along with maps, appendix and detailed glossary. A beautiful addition to the home library.

$113.70	Publisher's prices total
-$ 95.75	Your savings
$ 17.95	Book-of-the-Month Club price

JEFFERSON THE VIRGINIAN
JEFFERSON AND THE RIGHTS OF MAN
JEFFERSON AND THE ORDEAL OF LIBERTY
JEFFERSON THE PRESIDENT
JEFFERSON THE PRESIDENT
JEFFERSON AND HIS TIME
THE SAGE OF MONTICELLO

Jefferson and His Time by Dumas Malone

This landmark six-volume work is the definitive portrait of the most complex, elusive and fascinating of our presidents. "A masterly achievement of scholarship, the finest biography of Jefferson we have or are likely to have and a monumental triumph of the senior American historian"—*The New York Times Book Review*.

$109.90	Publisher's prices total
-$ 94.90	Your savings
$ 15.00	Book-of-the-Month Club price

Our Oriental Heritage
The Life of Greece
Caesar and Christ
The Age of Faith
The Renaissance
The Reformation
The Age of Reason Begins
The Age of Louis XIV
The Age of Voltaire
Rousseau and Revolution
The Age of Napoleon

The Story of Civilization by Will and Ariel Durant

For almost half a century Will and Ariel Durant traced the continuity of world history—the religions and philosophies, the political and economic tides, the arts and sciences, the customs and conquests—to show the foundations of society today. The Durants' 11-volume illustrated masterwork is history come alive in all its dimensions. The enormous scope of the work covers ancient and recent civilization, including Oriental as well as Western history. A magnificent centerpiece for any home library.

$307.45	Publisher's prices total
-$282.50	Your savings
$ 24.95	Book-of-the-Month Club price

The Encyclopedia of Philosophy

The most comprehensive encyclopedia of philosophy ever published, this set traces ancient, medieval, modern, Eastern and Western thought. An essential and rewarding reference source for home libraries.

$150.00	Publisher's price
-$130.05	Your savings
$ 19.95	Book-of-the-Month Club price

Benefits of Membership

Membership in the Book-of-the-Month Club begins with your choice of the extraordinary works offered here. Because our prices are generally lower than the publishers', you will save on works such as these throughout your membership as well as on the finest new fiction and nonfiction titles. In fact, the longer you remain a member, the greater your savings can be. Our Book-Dividend® plan, for which you become eligible after a brief trial enrollment, offers at least 70% off the publisher's price on art books, reference works, classics, books on cooking and crafts, literary sets and other contemporary works of enduring value. Nevertheless, all Book-of-the-Month Club books are equal in quality to the publishers' originals; they are not condensed versions or cheaply made reprints.

BOOK-OF-THE-MONTH CLUB®

America's Bookstore® since 1926.

BEETHOVEN NINE SYMPHONIES
THE CHICAGO SYMPHONY
SIR GEORG SOLTI
BEETHOVEN
The Five Piano Concertos
Vladimir Ashkenazy
Sir Georg Solti conducting The Chicago Symphony Orchestra

Available in 13 records or 8 cassettes.

The Nine Beethoven Symphonies & The Five Piano Concertos/Ashkenazy

A special offering of two of the most acclaimed recordings of Beethoven's works. Sir Georg Solti conducts the Chicago Symphony in the nine-record set of Beethoven's complete symphonies, hailed by *Time* as a "glorious musical combustion." In collaboration with soloist Vladimir Ashkenazy, Solti and the Chicago Symphony perform Beethoven's five concertos. *High Fidelity* calls it "a major addition to the Beethoven discography."

$115.74	List prices total
-$ 99.79	Your savings
$ 15.95	Book-of-the-Month Club price

Book-of-the-Month Club, Inc., Camp Hill, Pennsylvania 17012 the birds, and as the population declined further the proportion of males increased and sexual vigor decreased. By 1932 the population was extinct.

The effort to save the heath hen, like the bulk of conservation activities to date, centered on a single species. Recently, tracking a trend in ecology, conservationists have begun shifting their focus from single species to entire communities. Three common justifications are: that economics, science, and morality enjoin us to conserve the most species possible; that entire communities are aesthetically and scientifically interesting in their own right, above and beyond their component species; and that communities are integrated, holistic entities whose parts (species) cannot long survive removal from their biotic contexts.

The first two reasons are unassailable. The holistic nature of communities, a notion grounded in the popular conception of the balance of nature, is currently much debated among ecologists, but all agree that there are a number of obligatory relationships involving two or more species. In these cases, it would be impossible to conserve one species without also conserving the species that interact with it. Many plants, for example, can be pollinated only by specific animals, and many animals can eat only certain plants. Caterpillars of New York State's threatened Karner blue butterfly (*Lycaeides melissa samuelis*) can survive only on wild blue lupine (*Lupinus perennis*). If its food supply were lost, the Karner blue would go the way of the number of butterfly species that have become extinct in this century because their larval food plants were extirpated. If a specific community type is to be preserved, the relationships among the species within it must be understood. Virtually nonexistent for most communities, such knowledge is well within reach of ecologists, given sufficient funding and resources, but the commitment toward this type of research would have to be vastly increased.

In order to preserve a community or the most species possible, conservationists must ask the same questions they face when dealing with one target species: How much area should be set aside, and should it constitute a single large refuge or be dispersed among several smaller ones? Some ecologists, including Edward O. Wilson of Harvard, Jared Diamond of U.C.L.A., and Robert May of Princeton, have attempted to apply island biogeography theory, a branch of ecology, to conservation by likening refuges to islands. Island biogeography theory is a recent (1963) conception that envisions communities of species on islands as dynamic entities, with a number of species extinguished on each island per unit time and a number of species immigrating to the island per unit time. According to this theory, the number of immigrant species eventually equals the number of extinguished species, so that the number of species on the island approaches an equilibrium.

Since a refuge can be viewed as an island of wildlife habitat in a sea of less suitable area, the theory, these ecologists argue, should apply to refuges as well as to islands. Unfortunately, the theory of island biogeography has rarely been directly tested, and after reviewing the evidence, I believe the theory has not usually been shown to provide an accurate description of how natural communities operate.

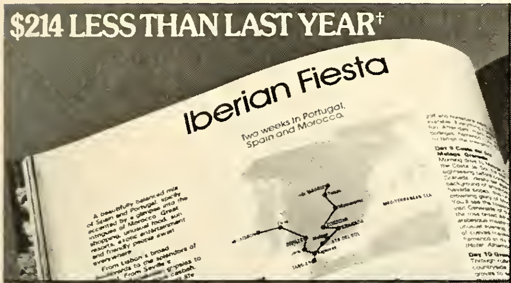
Naturalists have realized since 1835 that, all other things being equal, a larger area contains more species than a smaller one. This is known as the species–area relationship in ecology. At least two forces may contribute to this relationship. First and most important, larger areas tend to encompass more habitats, and since each habitat contains different species, the larger area holds more species. Second, local immigration to, and extinction on, isolated habitat patches, as envisioned by island biogeography theory, may play a role. Every population will go extinct sooner or later, and generally such locally extinguished populations are eventually replaced by immigrants from other populations of the same species. The larger an area, the longer it will likely take for any species' population to disappear, for all the reasons that dictate a minimum viable area for each species. Consequently, at any particular instant, fewer species will be locally extinct on a large patch than on a small one. Using insects on tiny mangrove islands, I have experimentally validated that immigration-extinction dynamics of this sort contribute to the species–area relationship on islands, but the same has not yet been done for other natural communities. Whether extinction and immigration rates for wildlife refuges would be high enough to render this effect important in conservation is unknown.

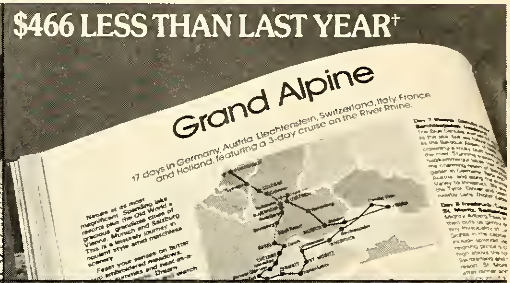
With respect to whether a given area, to contain the most species, ought to be in one block or several smaller ones, ecology again has few systematic, relevant data. This issue has just begun to be addressed. Some of the limited information already gathered pertaining to single-species conservation also bears on the matter of one large versus several small refuges when maximum species diversity is the goal. If, for whatever reason, each of the several small refuges is so small that its area is below that required by the minimum population sizes of most species, none of them can maintain many species and all would probably contain many of the same species. Then all combined would likely have fewer species than a single large refuge would have. The relevant questions here are empirical. How many species are held in common among the small refuges? How frequently do individuals move between them? What are the minimum population sizes for all species?

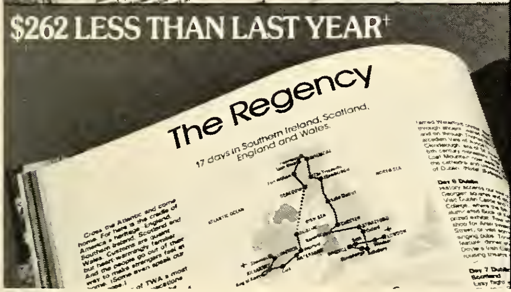
Several theoretical papers based primarily on island biogeography theory propose that, as a general rule, one large refuge will maintain more species than will several small ones. Blaine Cole of the University of Utah has theorized that the only time a pair of small refuges will have more species than a single, larger one is when all refuges, large or small, are so small that none contains more than a tiny fraction of the available biota. If one scans published data that bear on this point, however, an unexpected pattern emerges. The only direct experimental test is my work on insects and spiders of five small mangrove islands of the Florida Keys. Several years ago I censused these to find how many species were present, then dug channels through them to turn each one into an archipelago of two to five islands. Since the channels are narrow, each archipelago has approximately the same area as the island from which it was constructed. Nevertheless, the channels constitute major barriers to most arboreal arthropods in the mangrove, many of which are flightless. I have collected data so far on two of these archipelagoes and discovered that each has a number of species similar to the number it had as a single island (81 versus 77 and 47 versus 56, respectively). The archipelago showing the decrease in species is much smaller than the one showing the increase, and its islands may be too small to maintain minimum viable populations of most species.

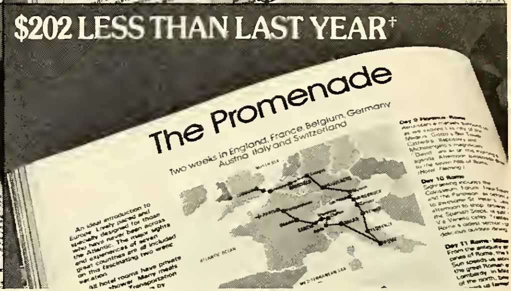
Other attempts to see if a group of small islands or habitat patches has more species than a single large one are inferential rather than experimental: species lists for large and small patches are compiled; then the lists for a group of small patches are merged and com-

This year, TWA Getaway® Europe gets you more Europe for less.*


$214 LESS THAN LAST YEAR†
Iberian Fiesta
Two weeks in Portugal, Spain and Morocco.


$466 LESS THAN LAST YEAR†
Grand Alpine
17 days in Germany, Austria, Liechtenstein, Switzerland, Italy, France and Holland, featuring a 3-day cruise on the River Rhine.


$262 LESS THAN LAST YEAR†
The Regency
17 days in Southern Ireland, Scotland, England and Wales.


$202 LESS THAN LAST YEAR†
The Promenade
Two weeks in England, France, Belgium, Germany, Austria, Italy and Switzerland

†Savings based on two persons, double occupancy, excluding air fare.

This year, TWA's European Vacations are better buys than they have been in years. So if you're wondering whether you can afford a trip to Europe, you probably can. And if you're already planning one, now you can get more vacation for your money.

For 1982, TWA offers a wider selection than ever. There are 68 Getaway Vacations ranging from 8 days to 4 weeks. And they're priced up to $233 less than last year. Imagine spending 8 days in London for under $300, plus air fare.** And our 12 Super Saver Vacations start as low as $449, plus air fare, for two weeks.◇ They're a great way to get the most out of Europe for less.

TWA lets you choose the type of travel that suits you best. From the flexibility of our Freestyle vacations to our professionally guided Escorted vacations, we have something for everyone.

And all TWA European Vacations are famous for their high quality. Expert tour directors, fine hotels, private motorcoaches and more make our vacations a memorable experience for any traveler.

So if you're looking for a great way to see Europe, you don't have to look any further than TWA. Take a Getaway or Super Saver Vacation. For more information, call your travel agent today, or send in the coupon below for one of our free 1982 brochures.

FREE TWA GETAWAY® AND SUPER SAVER BROCHURES

Getaway Europe ☐ (H) Super Saver Europe ☐ (Z)

Just check the appropriate box and mail to:
TRANS WORLD AIRLINES, P.O. Box 625,
Rockville Centre, N.Y. 11571.

Name____________________

Address____________________

City__________ State________ Zip______

NATO4

TWA SUPER SAVER
EUROPE
TWA GETAWAY
EUROPE
1982

You're going to like us TWA

---

*10 out of 80 packages cost the same or slightly more than 1981.

**Packages range from $269 to $395 per person based on double occupancy for London.

◇$449 to $849 per person based on double occupancy for Super Saver Vacations.

Share the Thrills of Exploring Outer Space!

$359.95 f.o.b. Hartford, Conn.

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

Criterion Manufacturing Co.
620 Oakwood Ave., W. Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION. MANUFACTURING CO., Dept. NH 113
620 Oakwood Avenue, W. Hartford, Conn. 06110
Please send your free Telescope Guide.

Name__________

Address__________

City__________ State__________

Enjoy the romance...
Send for a luxurious color catalogue of beautiful lingerie. French bra and bikini sets, lacy teddies, gowns, kimonos & much more.

Victoria's Secret

Send $3 to Victoria's Secret, Dept. NH-04
Box 31442, San Francisco, CA 94131
Boutiques: San Francisco, Palo Alto & Cupertino

pared with the list for one larger patch. Two small coral heads, for example, have been found to house more species of crustaceans than one large one, while two large coral heads and one very large one do not differ consistently. Data on New Jersey forest birds show no significant difference between diversities of one large and several small forests, and a similar result arises from a study on birds and plants of Swedish islands. For breeding land birds, mammals, and higher plants of Yorkshire, England, there are no consistent diversity differences between single large areas and pairs of smaller ones.

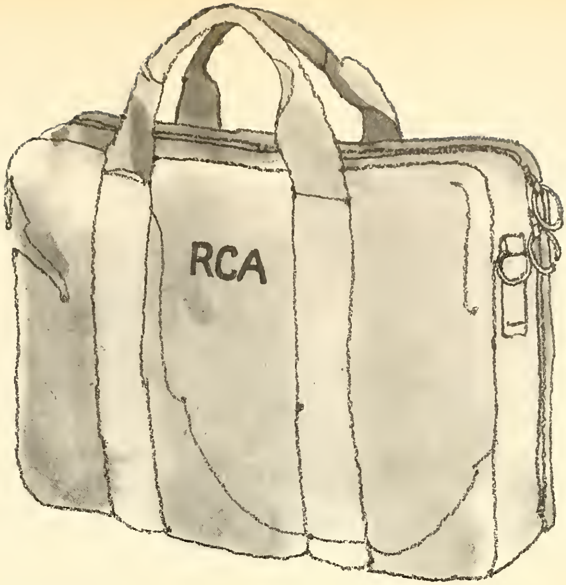
By contrast, data for mountaintop mammals and birds in the American Great Basin show two small mountaintops containing more species than one large one. The same result obtains for lowland forest birds of the New Hebrides: pairs of small islands typically contain 5 to 10 percent more species than one large island. In England, two small Lincolnshire woods usually contain more plant species than one large one does, even if the small woods are randomly chosen. If the small woods are selected to maximize habitat diversity, their superiority over one large woods is enhanced. For plants of Yorkshire limestone pavements, chalk quarry reserves, and lowland heaths, as well as soft coastal habitats in Scotland, two or more small sites usually contain more species than one equal-sized large one. L.I. Malyshev of the Siberian Central Botanical Garden came to a similar conclusion for plants of several regions, mostly in the Soviet Union. Finally, combinations of small plots in Finland's Åland Archipelago contain at least as many plant species as single large plots.

The evidence, then, belies the theories that advocate one large refuge. For a variety of plants and animals in many parts of the world, a group of small sites contains more species than does one large site. In some comparisons there is no difference, but in no instance is the one large site better. Furthermore, several of these results (for example, New Hebrides islands, Great Basin mountaintops) involve sites as large as the largest extant refuges; the findings are not an idiosyncrasy of small areas. If diversity is the goal, a network of small refuges might be a better conservation strategy than one large one, at least as long as the small ones are large enough to support a minimum viable population for most target species.

Connecting the refuges by corridors might also be advantageous, but the advantages (especially lowering inbreeding) and disadvantages (spreading of disasters such as fires or contagious diseases) of such a design would have to be balanced. The disadvantages may well be critical. An interesting natural experiment of this sort is occurring on the Seychelles Islands, an archipelago of four main islands and about twenty-four small ones in the Indian Ocean. When Europeans came in 1770, they found seventeen land-bird species. Since then, habitat destruction and a series of disastrous fires and predator introductions have caused the tragic destruction so typical of tropical islands, but only two birds, the green parakeet (*Psittacula eupatria wardi*) and the chestnut-flanked white-eye (*Zosterops semiflava*), are extinct. The loss is almost surely limited partly because there are several small islands and not just one large one: fires and introduced predators were unable to reach all the islands. The Seychelles magpie robin (*Copsychus sechellarum*), for example, remains only on Frigate Island, which is so small that the introduced cats that killed the robin population elsewhere could be controlled. Frigate's isolation prevents cats from reimmigrating.

This whole matter of refuge size and configuration is secondary to habitat considerations, and the key requirement for determining what habitat to set aside is detailed ecological knowledge of a large fraction of the individual species. Such knowledge would likely make the advantage of several small reserves over one large one even more pronounced. Darrell Kitchener of the Western Australian Museum and his associates recently studied the lizards of Western Australia's wheat belt and learned that the number of vegetation associations in a refuge is the main determinant of how many lizard species it will contain. They concluded that "while scattered small reserves [totaling 44,000 acres] contain almost all known lizard species in the central and southern wheat belt," a single area in the same region and with the same characteristics "would have to be immensely larger—possibly by a factor of 600," to contain the same number of lizard species. In short, knowledge of the necessary habitat allows a network of small reserves to have a diversity of habitats, thus a diversity of species. A single large reserve would have to be very large and/or extraordinarily situated to contain the same habitat diversity.

Another recent theoretical suggestion for refuge design—that when areas are



Why this Chicago ad man leaves his $200 case in the closet and carries our $29.50 attache.

Dick Anderson, an Executive Vice President of Needham, Harper and Steers, explains it this way:

"I'm always trying to jam more things into an attache than it was ever meant to hold. That plays hell with stiff-backed cases. So I find myself leaving my $200 leather case in the closet, and carrying my canvas Consort Attache. It swallows overloads without complaint, has inside pockets for my calculator and slide rule, even a snap hook for keys."

And more.

That's not even the whole story of our Consort. It's made of tough yet soft 18 oz. Square Rigger cotton canvas. Has comfortable padded handles. Smooth-operating YKK zippers. Comes in four businesslike colors. Pretty impressive for $29.50. And we'll add your monogram for just $5 more.

We make the Consort and over a hundred other Lands' End items at our duffle works in Boscobel, Wisconsin. That way we can guarantee the best possible materials and workmanship. And sell our soft luggage to you without middleman mark-ups.

First quality, then price.

What we have to offer goes beyond soft luggage, even beyond our great sportswear and accessories. The Lands' End tradition affects everything we offer you.

First, *quality.* Then, *price.* And always, always *service.*

That's why we offer a guarantee that would put lesser merchants out of business. Simply: "If you are not completely satisfied with any item you buy from us, at any time during your use of it, return it and we will refund your full purchase price."

If we're new to you, we don't ask that you trust us. Just try us. By phone, you can reach us toll-free 24 hours a day at 800-356-4444 (except Wisconsin call 608-935-2788). Or fill in the coupon. Order a Consort or not, as you like. But let us send you a free copy of our Lands' End catalog.

☐ Please send free
76-page catalog.
Lands' End Dept. P-02
Dodgeville, WI 53533

Ship_____ Consort Attaches. $29.50 ea.
plus $2.50 shpg. ☐ Tan ☐ Navy
☐ Brown ☐ Grey

$5.00 to monogram 3 initials: ☐☐☐

☐ Check enclosed ☐ American Express
☐ Visa ☐ Master Card

Card No. ________________

Expiration Date ________________

Name ________________

Address ________________

City ________________

State ________ Zip ________

Or call Toll-free:

800-356-4444

(Except Wisconsin call 608-935-2788)

LANDS' END
DIRECT MERCHANTS

of fine wool and cotton sweaters, Oxford buttondown shirts, traditional dress clothing, snow wear, deck wear, original Lands' End soft luggage and a multitude of other quality goods from around the world.

BE SURE YOUR NORTH COUNTRY TOUR INCLUDES

ALASKA'S GLACIER BAY

Insist on it; schedule your visit to Glacier Bay National Park. It's the highlight of any Alaska tour. Especially the way we show it to you. Alaska Exploration Holidays offers your greatest choice of experiences in this treasured preserve of active glaciers and marine wildlife: two different overnight cruises or a day cruise with accommodations at Alaska's Premiere Wilderness Resort, Glacier Bay Lodge. See Glacier Bay as a part of your Alaska Exploration Tour or as a feature of any independent itinerary. We'll tell you how! Either way, don't miss it. Send for our free full-color brochure today, or see your travel agent. Ask about Special Thrift Season Rates!

ALASKA EXPLORATION HOLIDAYS AND CRUISES
1500 Metropolitan Park Bldg. Dept. NH-GB4
Seattle, WA 98101

NAME

ADDRESS

CITY STATE ZIP

Division of Alaska Tour & Marketing Services, Inc.

Monuments of Time

The Kawai piano is perfection obtained by the hand of time. Your investment in Kawai enhances with time.

Kawai America Corporation
24200 So. Vermont Ave., Harbor City, Calif. 90710

KAWAI

equal, a round refuge is preferable to a long narrow one—has not been directly examined. The idea springs from the "peninsula effect," a biogeographic generalization first enunciated in 1964 by George Gaylord Simpson, who noticed that the species diversity of mammals on all North American peninsulas decreases from base to tip. Similar observations were subsequently made for other groups of animals. While pointing out the absence of relevant data, Simpson and later workers suggested that fewer individuals might reach a peninsular tip because of its greater distance from the mainland.

The possibility of decreased immigration also provides the basis of the idea that a narrow refuge is inferior to a round one, but little new evidence has come forth. Three recent studies of the peninsula effect, for Florida birds, Baja California rodents, and Baja California reptiles, all ascribe the reduction in species toward the peninsular tip primarily to habitat differences along the peninsula, not to decreased immigration. These results cast doubt on the contention that immigration difficulties would be important in refuges, which will certainly be smaller than Florida or Baja California.

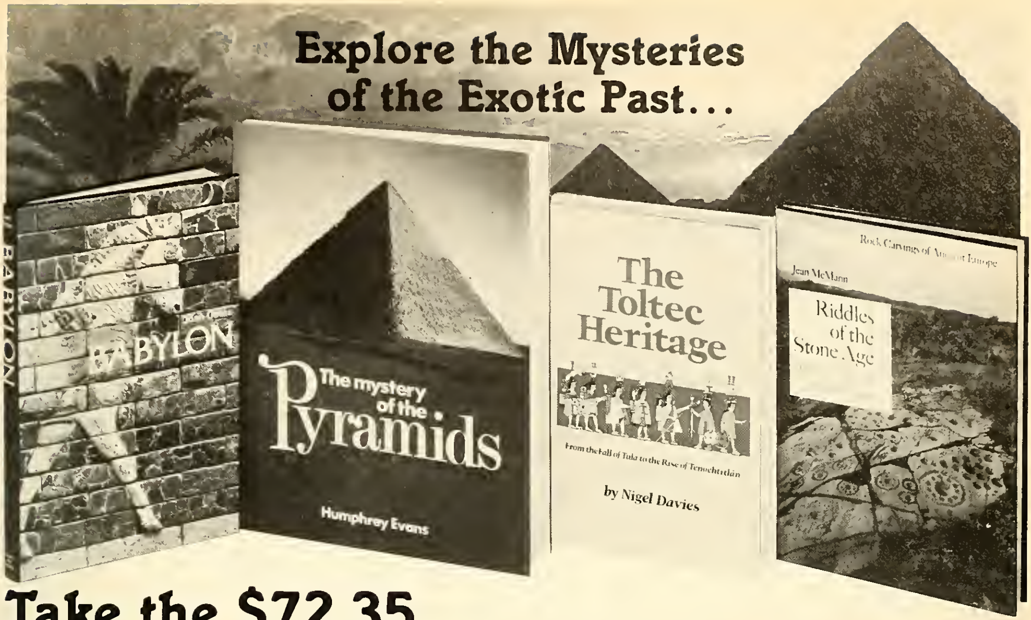
Theoretical considerations may also militate against the belief that round refuges are generally superior. When areas are equal, the narrower of two refuges will have the larger perimeter, and this may make it more visible to potential immigrants from outside. Ecologists have also long noted an edge effect; that is, borders between two habitats tend to have more species than either of the habitats. Since the larger perimeter of narrow refuges gives them more edge, they might therefore contain more species. Moreover, several small refuges will have more edge than one large refuge, so the edge effect may be relevant beyond matters of refuge shape.

However the debate over the best refuge configurations is resolved, captive propagation can help maintain species undergoing decline. Zoos and botanical gardens can try to breed animals and plants for release in the wild or in refuges. A few species exist today largely or wholly in captivity. About one-twelfth of all bird species and one-sixth of all mammals have bred in zoos recently, and this proportion can be increased. New technologies such as embryo implants augur well for captive propagation.

But captive propagation is a temporary measure, a modern Noah's ark to carry us through the current flood of extinctions until we are able to return plants and animals to a wild existence or to refuges. Eternal captive propagation is not an option, and extinction is the eventual fate of any small zoo population. The likelihood of any particular disaster, such as the flood and war that together expunged the Chinese populations of Père David's deer at the turn of the century, may be low, but the probability of some such catastrophe's hitting a captive population is much higher. Contagious diseases and fires, for example, can easily ravage a zoo herd. In addition, the cost of maintaining captive populations soon becomes prohibitive. William Conway of the Bronx Zoo estimates that all American zoos together could maintain no more than 150 mammal species because of space limitations and expenses.

An ample number of well-designed refuges, then, must underpin any long-term conservation effort. Beyond the literature on habitat requirements of given species and the observation that larger total areas contain more species, ecology can provide no general guidelines. The utility of the theory of island biogeography as a guide to refuge design is extremely doubtful, although it may suggest questions that a refuge planner might ask, such as how much immigration would be expected into a proposed refuge.

To me, the problems seem fundamentally economic, not ecological, and the prognosis pessimistic. Any refuge costs money to obtain and administer, and the total area required to represent most major habitat types will be far more than is currently set aside. Economic considerations have not been widely studied, but such differences as costs of acquisition and maintenance between one large and several small refuges may limit the extent to which a biologically sound strategy can be implemented. Further, the habitats can often be used at great short-term profit for purposes other than conservation: mining, cultivation, and power generation, for example. The current American political climate only worsens an already bad situation. The problem is not lack of ingenuity; if we can enlist the aid of pearly-eyed thrashers in producing a safe refuge for Puerto Rican parrots, we can probably, with sufficient study, solve any technical or scientific problems that refuge design and management may pose. Our resolve, unfortunately, is a very different matter. ☐


Explore the Mysteries of the Exotic Past...
BABYLON
BABYLON
The mystery of the Pyramids
Humphrey Evans
The Toltec Heritage
From the Fall of Tula to the Rise of Tenochtitlán
by Nigel Davies
Rock Carvings of Ancient Europe
Jean McMann
Riddles of the Stone Age

Take the $72.35 Library of Ancient Civilizations for only $2.95

when you join the Natural Science Book Club.

You simply agree to buy 3 more books—at handsome discounts—within the next 12 months.

Here's a fantastic opportunity to get this beautiful $72.35 set of 4 oversized volumes for only $2.95. They present a fascinating view of the development of mankind.

BABYLON. *Joan Oates.* This remarkably detailed history—beautifully illustrated with 137 photographs, maps and drawings. A complete picture of the ancient city, the men who ruled it and those who came to conquer it. Publisher's Price $17.95

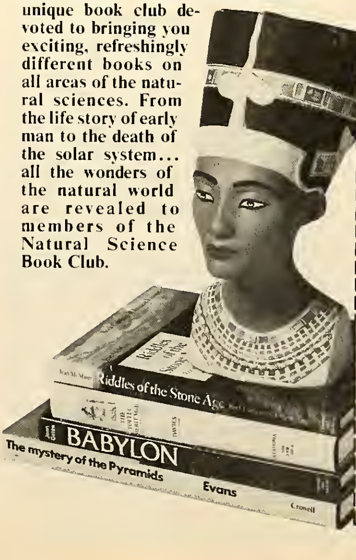
THE MYSTERY OF THE PYRAMIDS. *Humphrey Evans.* A fascinating tour into an Egyptian time capsule that lays out the rise and fall of dynasties, explains the evolution of burial procedures and discusses the architecture that existed alongside generations of pharaohs. Over 100 full-color photographs. Publisher's Price $19.95

THE TOLTEC HERITAGE. *Nigel Davies.* The remarkable story of a nomadic people who crossed the boundary dividing savagery from civilization. Davies exposes the cruel and bloodthirsty practices of this warrior culture along with their successors—the Chichimecs and Tepanecs. A coherent and highly readable account. Extensively illustrated. Publisher's Price $17.50

RIDDLES OF THE STONE AGE. *Jean McMann.* Fascinating answers to the meaning of the enigmatic rock carvings of ancient Europe. From Ireland to Brittany, to Italy. Reveals how the symbols reflect the metaphors and myths of their ancient creators, and may be the first attempt to evolve a written language. Over 150 illustrations. Publisher's Price $16.95

The Natural Science Book Club, is a unique book club devoted to bringing you exciting, refreshingly different books on all areas of the natural sciences. From the life story of early man to the death of the solar system... all the wonders of the natural world are revealed to members of the Natural Science Book Club.

MEMBERSHIP BENEFITS • In addition to getting the Library of Ancient Civilizations for only $2.95 when you join, you keep saving substantially on the books you buy. • Also, you will immediately become eligible to participate in our Bonus Book Plan, with savings up to 70% off the publishers' prices. • At 3-4 week intervals (16 times per year) you will receive the Book Club News, describing the coming Main Selection and Alternate Selections, together with a dated reply card. • If you want the Main Selection, do nothing and it will be sent to you automatically. • If you prefer another selection, or no book at all, simply indicate your choice on the card, and return it by the date specified. • You will have at least 10 days to decide. If, because of late mail delivery of the News, you should receive a book you do not want, we guarantee return postage.



Natural Science Book Club
Riverside, New Jersey 08075 4-AT9

Please accept my application for trial membership and send me the Library of Ancient Civilizations F(10103), billing me only $2.95. I agree to purchase at least three additional Selections or Alternates over the next 12 months. Savings range up to 30% and occasionally even more. My membership is cancelable any time after I buy these three books. A shipping and handling charge is added to all shipments.

No-Risk Guarantee: If you are not satisfied—for any reason—you may return The Library of Ancient Civilizations within 10 days and your membership will be canceled and you will owe nothing.

Name__________
Address__________Apt.____
City__________
State______Zip______
(Offer good in Continental U.S. and Canada only. Prices slightly higher in Canada.)

The Importance of Trifles

Darwin used the lowly worm to reveal lofty principles of scientific reasoning

by Stephen Jay Gould

In the preface to his last book, an elderly Charles Darwin wrote: "The subject may appear an insignificant one, but we shall see that it possesses some interest; and the maxim 'de minimis lex non curat' [the law is not concerned with trifles] does not apply to science."

Trifles may matter in nature, but they are unconventional subjects for last books. Most eminent graybeards sum up their life's thought and offer a few pompous suggestions for reconstituting the future. Charles Darwin wrote about worms—*The Formation of Vegetable Mould, Through the Action of Worms, With Observations on Their Habits* (1881).

This month marks the one-hundredth anniversary of Darwin's death—and celebrations are under way throughout the world. Most symposiums and books are taking the usual high road of broad implication—Darwin and modern life or Darwin and evolutionary thought. For my personal tribute, I shall take an ostensibly minimalist stance and discuss Darwin's "worm book." But I do this to argue that Darwin justly reversed the favorite maxim of his legal colleagues.

Darwin was a crafty fellow. He liked worms well enough, but his last book, although superficially about nothing else, is (in many ways) a covert summation of the principles of reasoning that he had labored a lifetime to identify and use in the greatest transformation of nature ever wrought by a single man. In analyzing his concern with worms, we may grasp the sources of Darwin's general success.

The book has generally been interpreted as a curiosity, a harmless work of little importance by a great naturalist in his dotage. Some authors have even used it to support a common myth about Darwin that recent scholarship has extinguished. Darwin, his detractors argued, was a man of mediocre ability who became famous by the good fortune of his situation in place and time. His revolution was "in the air" anyway, and Darwin simply had the patience and pertinacity to develop the evident implications. He was, Jacques Barzun once wrote (in perhaps the most inaccurate epitome I have ever read), "a great assembler of facts and a poor joiner of ideas . . . a man who does not belong with the great thinkers."

To argue that Darwin was merely a competent naturalist mired in trivial detail, these detractors pointed out that most of his books are about minutiae or funny little problems—the habits of climbing plants, why flowers of different form are sometimes found on the same plant, how orchids are fertilized by insects, four volumes on the taxonomy of barnacles, and finally, how worms churn the soil. Yet all these books have both a manifest and a deeper or implicit theme—and detractors missed the second (probably because they didn't read the books and drew conclusions from the titles alone). In each case, the deeper subject is evolution itself or a larger research program for analyzing history in a scientific way.

Why is it, we may ask at this centenary of his passing, that Darwin is still so central a figure in scientific thought? Why must we continue to read his books and grasp his vision if we are to be competent natural historians? Why do scientists, despite their notorious unconcern with history, continue to ponder and debate his works? Three arguments might be offered for Darwin's continuing relevance to scientists.

We might honor him first as the man who "discovered" evolution. Although popular opinion may grant Darwin this status, such an accolade is surely misplaced, for several illustrious predecessors shared his conviction that organisms are linked by ties of physical descent. In nineteenth-century biology, evolution was a common enough heresy.

As a second attempt, we might locate Darwin's primary claim upon continued scientific attention in the extraordinarily broad and radical implications of his proffered evolutionary mechanism—natural selection. Indeed, I have pushed this theme relentlessly throughout seven years of columns, focusing upon three arguments: natural selection as a theory of local adaptation, not inexorable progress; the claim that order in nature arises as a coincidental byproduct of struggle among individuals; and the materialistic character of Darwin's theory, particularly his denial of any causal role to spiritual forces, energies, or powers. I do not now abjure this theme, but I have come to realize that it cannot represent the major reason for Darwin's continued *scientific* relevance, though it does account for his impact upon the world at large. For it is too grandiose, and working scientists rarely traffic in such abstract generality.

Everyone appreciates a nifty idea or an abstraction that makes a person sit up, blink hard several times to clear the intellectual cobwebs, and reverse a cherished opinion. But science deals in the workable, the doable, the idea that can be fruitfully embodied in concrete objects suitable for poking, squeezing, manipulating, and extracting. It is, as Peter Medawar says, "the art of the *soluble*." The idea that counts in science must lead to fruitful work, not only to speculation that does not engender empirical test, no matter how much it stretches the mind.

I therefore wish to emphasize a third argument for Darwin's continued importance, and to claim that his greatest achievement lay in establishing principles of *useful* reason for sciences (like evolution) that attempt to reconstruct history. The special problems of historical science (as contrasted, for example, with experimental physics) are many, but one stands out most prominently: Science must identify processes that yield observed results. The results of history lie strewn around us, but we cannot, in principle, directly observe the processes that produced them. How then can we be scientific about the past?

Clip and mail postage free card today for FREE Sea Eagle color brochure and Information Fact Kit!

"Your best buy in boating today!"

Al Lindner, pro fisherman

SEA EAGLE

INFLATABLE BOATS

FREE!

Please rush me FREE information and color brochure.

(Just fill in box below and mail)

I'm interested in:

☐ Fishing platforms
☐ River rafts
☐ Yacht tenders
☐ Skin diving
☐ Whitewater Canoes
☐ Pack boats
☐ Canoes
☐ Sportboats

name

address

city state zip

telephone

MAIL CARD TODAY

Or phone 516-724-8900
Mon – Fri, 8:30 AM to 4:30 PM, EST

SEA EAGLE®

NH4B

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 53, ST. JAMES, NY

POSTAGE WILL BE PAID BY

SEA EAGLE

a division of Harrison-Hoge Industries, Inc.
104 ARLINGTON AVENUE
ST. JAMES, NY 11780

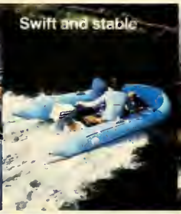
The Quality Alternative to High-Cost Inflatable Boats!

SEA EAGLE 330

Explore wilderness rivers

Family fun!

Fish quiet waters


Swift and stable

Pack it in!

Two of Our Most Popular Models

Sea Eagle Heavyweight 6 (left)	Sea Eagle Heavyweight 8
8'8" x 4'4"	9'7" x 4'6"
Holds three adults (750 lbs.)	Holds four adults (900 lbs.)
2 hp capacity	3 hp capacity
Weighs just 24 lbs.	Weighs just 31 lbs.
Costs just $180.	Costs just $220.

SEA EAGLE®

boats for people who love water!

Why pay $600, $1000 or even more for an inflatable boat?

Sea Eagles pack small, last for years and prices start at just $110.00.

For lakes, rivers, ponds, bays and even ocean surf.

Fishing, camping, duck hunting, river-running, yacht tending . . . Sea Eagles give you more for your money.

Canoes, pack boats, river rafts, fishing platforms, and motor-mount boats.

Clip and mail card today for free Sea Eagle catalog and information kit!

Or phone: 516-724-8900, 8:30 AM to 4:30 PM, Monday – Friday, Eastern Standard Time.

NH4B

☐ **Please rush me FREE brochure**

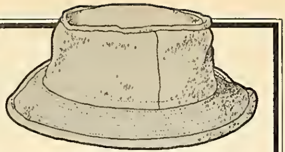
name

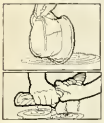
address

city

state zip

► **Sea Eagle, St. James, NY 11780**





THICK 'N THIRSTY TOWELING HAT

100% cotton terry cloth beats summer heat 2 ways: Use it to wipe your perspiring brow or douse it in water, wring it out and wear to keep cool at golf, tennis, jogging and fishing. **Colors:** Navy Blue, Powder Blue, White, Yellow.
Sizes: S(6¾-6⅞), M(7-7⅛), L(7¼-7⅜), XL (7½-7⅝), XXL(7¾-7⅞). **$7.75 ppd.**

Order Today! Money Back Guarantee!
Here is my check or money order for $________
(Add sales tax for shipment into CA, CO, D.C., IL, MA, MI, MN, PA, WA).
RUSH my **#2002 Toweling Hat.**
Size__________ Color______________
Name ______________________
Address ______________________
City ______________________
State______________ Zip__________
☐ **Send me your FREE outdoor catalog.**

Eddie Bauer®
Dept. YNH, Fifth & Union, Seattle, WA 98124

AlaskA
TRAVEL ADVENTURES

Where Adventure Begins
We feature:

- Backcountry Adventures
- River Trips
- Inside Passage
- National Parks
- Fishing

Call for free brochure describing 50 adventures:

Toll Free: 800-227-8480
Northern Cal.: 415-329-9013
Southern Cal.: 213-859-3959

Alaska Travel Adventures
525 University Ave. #610-Z
Palo Alto, CA 94301

NORTHWEST ORIENT
THE WORLD IS GOING OUR WAY!

As a general answer, we must develop criteria for inferring the processes we cannot see from results that have been preserved. This is the quintessential problem of evolutionary theory: How do we use the anatomy, physiology, behavior, variation, and geographic distribution of modern organisms, and the fossil remains in our geological record, to infer the pathways of history?

Thus, finally, and after too long a prologue, we come to the covert theme of Darwin's worm book, for it is both a treatise on the habits of earthworms and an exploration of how we can approach history in a scientific way.

Darwin's mentor, the great geologist Charles Lyell, had been obsessed with the same problem. He argued, though not with full justice, that his predecessors had failed to construct a science of geology because they had not developed procedures for inferring an unobservable past from a surrounding present and had therefore indulged in unprovable reverie and speculation. "We see," he wrote in his incomparable prose, "the ancient spirit of speculation revived and a desire manifestly shown to cut, rather than patiently to untie, the Gordian Knot." His solution, an aspect of the complex world view later called uniformitarianism, was to observe the work of present processes and to extrapolate their rates and effects into the past. Here Lyell faced a problem. Many results of the past—the Grand Canyon for example—are extensive and spectacular, but most of what goes on about us every day doesn't amount to much—a bit of erosion here or deposition there. Even a Stromboli or a Vesuvius will cause only local devastation. If modern forces do too little, then we must invoke more cataclysmic processes, now expired or dormant, to explain the past. And we are in catch-22: if past processes were effective and different from present processes, we might explain the past in principle, but we could not be scientific about it because we have no modern analogue in what we can observe. If we rely only upon present processes, we lack sufficient oomph to render the past.

Lyell sought salvation in the great theme of geology: time. He argued that the vast age of our earth provides ample time to render all observed results, however spectacular, by the simple summing of small changes over immense periods. Our failure lay, not with the earth, but with our habits of mind: we had been previously unwilling to recognize how much work the most insignificant processes can accomplish with enough time.

Darwin approached evolution in the same way. The present becomes relevant, and the past therefore becomes scientific, only if we can sum the small effects of present processes to produce observed results. Creationists did not use this principle and therefore failed to understand the relevance of small-scale variation that pervades the biological world (from breeds of dogs to geographical variation in butterflies). Minor variations are the stuff of evolution (not merely a set of accidental excursions around a created ideal type), but we recognize this only when we are prepared to sum small effects through long periods of time.

Darwin recognized that this principle, as a basic mode of reasoning in historical science, must extend beyond evolution. Thus, late in his life, he decided to abstract and exemplify his historical method by applying it to a problem apparently quite different from evolution—a project broad enough to cap an illustrious career. He chose earthworms and the soil. Darwin's refutation of the legal maxim "de minimis lex non curat" was a conscious double-entendre. Worms are both humble and interesting, and a worm's work, when summed over all worms and long periods of time, can shape our landscape and form our soils.

Thus, Darwin wrote at the close of his preface, refuting the opinions of a certain Mr. Fish who denied that worms could account for much "considering their weakness and their size":

> Here we have an instance of that inability to sum up the effects of a continually recurrent cause, which has often retarded the progress of science, as formerly in the case of geology, and more recently in that of the principle of evolution.

Darwin had chosen well to illustrate his generality. What better than worms: the most ordinary, commonplace, and humble objects of our daily observation and dismissal. If they, working daily beneath our notice, can form much of our soil and shape our landscape, then what event of magnitude cannot arise from the summation of small effects. Darwin had not abandoned evolution for earthworms; rather, he was using worms to illustrate the general method that had validated evolution as well. Nature's mills, like God's, grind both slowly and exceedingly small.

Darwin made two major claims for worms. First, in shaping the land, their effects are directional. They triturate

Should You Collect Rare U.S. Stamps for PLEASURE or PROFIT?

Both . . . How else could you hold history in your hands *and profit* from rising rare stamp values?

INTRODUCING . . .

FNI — America's Largest, Rare U.S. Stamp Investment Society

Now, for as little as $20 a month, you can acquire an heirloom portfolio of Rare U.S. Stamps — strictly on approval.

Ten Years Ago These Two Stamps Sold for $87.75 . . .

TODAY $660.00!

YES, in 1972 the 3¢ stamp featured on the left sold for $18.75. Today $110.00. The stamp on the right sold for $69.00 ten years ago -- now it's worth $550.00.

YOU WILL RECEIVE $19.45 IN FREE GIFTS

As a member you'll receive these free gifts:

- * **FREE** — Deluxe display album worth $10.25
- * **FREE** — Harris U.S. Stamp Catalog worth $2.95
- * **FREE** — Subscription to "Investment Opportunity Newsletter" worth $6.25.

Here's How You Can Benefit:

As an F.N.I. subscriber you'll receive a monthly selection of Rare U.S. Stamps worth $20 — sent to you strictly on approval. You will have 30 days to purchase them, or return them. And you are never obligated to purchase a single stamp. You can even skip a month, purchase more, or cancel at any time.

Limited Time Offer!

Due to the limited supply, and ever-increasing demand for Rare U.S. Stamps we can only accomodate a limited number of members. So complete the application below and return it today to receive your free gifts. It should be noted that past performance is *no guarantee* that rare stamps will continue to increase in value.

Send No Money Now

Remember, you never pay in advance, and stamps will be sent to you monthly, on approval. There is no contract to sign and no strings attached. Act now while this offer is still available.

100% SATISFACTION GUARANTEED

$19.45 VALUE

1st FNI INCORPORATED

Fill out and mail to: 313 Nolana Ave.
Dept. Y31, McAllen, TX. 78501

YES! **Please accept my membership to FNI and send my first investment package on approval along with my free gifts.**

$19.45 VALUE

☐ Please Bill Me ☐ Charge to (check one) ☐ Master Charge ☐ Visa Credit Card

Print Name ______

Address ______

City State Zip ______

Phone ( ) ______

Credit Card Acct. No. ______ Valid Thru ______ Signature ______

Rare U.S. Stamp Investment Society

PICK UP A BARGAIN IN EUROPE.

AS LITTLE AS $112 A WEEK.

With the Hertz Affordable Europe program you'll get a great weekly rate on a fuel-efficient subcompact with unlimited free mileage.

Rent a car in Germany for example, for as little as $112. Or in Spain for as little as $119.* And get all the extras you expect from #1:

- Over 600 locations throughout Europe.
- No pre-payment. Hertz is the only major rental car company that doesn't require payment when you book.
- Rates guaranteed in local European currency.
- Hertz emergency service network on call all over Europe.

For further details and other European rates see your travel consultant, or call Hertz at 1-800-654-3001.

Hertz also has low weekly rates on larger cars. Cars must be reserved at least 14 days in advance. These rates are non-discountable and do not include gas or optional charges. *Rates are guaranteed in local European currency from April 1, 1982-March 31, 1983 (Germany $112/252 marks, Spain $119/11,550 pesetas). Dollar equivalents may fluctuate with changing exchange rates.

Hertz

AFFORDABLE EUROPE

HERTZ RENTS FORDS AND OTHER FINE CARS.

® REG U S PAT OFF © HERTZ SYSTEM INC 1982

particles of rock into ever smaller fragments (in passing them through their gut while churning the soil), and they denude the land by loosening and disaggregating the soil as they churn it; gravity and erosive agents then move the soil more easily from high to low ground, thus leveling the landscape. The low, rolling character of topography in areas inhabited by worms is, in large part, a testimony to their slow but persistent work.

Second, in forming and churning the soil, they maintain a steady state amidst constant change. As the primary theme of his book (and the source of its title), Darwin set out to prove that worms form the soil's upper layer, the so-called vegetable mold. He describes it in the opening paragraph:

> The share which worms have taken in the formation of the layer of vegetable mould, which covers the whole surface of the land in every moderately humid country, is the subject of the present volume. This mould is generally of a blackish color and a few inches in thickness. In different districts it differs but little in appearance, although it may rest on various subsoils. The uniform fineness of the particles of which it is composed is one of its chief characteristic features.

Darwin argues that earthworms form vegetable mold by bringing "a large quantity of fine earth" to the surface and depositing it there in the form of castings. (Worms continually pass soil through their intestinal canals, extract anything they can use for food, and "cast" the rest; the rejected material is not feces but primarily soil particles, reduced in average size by trituration and with some organic matter removed.) The castings, originally spiral in form and composed of fine particles, are then disaggregated by wind and water, and spread out to form vegetable mold. "I was thus led to conclude," Darwin writes, "that all the vegetable mould over the whole country has passed many times through, and will again pass many times through, the intestinal canals of worms."

The mold doesn't continually thicken after its formation, for it is compacted by pressure into more solid layers a few inches below the surface. Darwin's theme here is, not directional alteration, but continuous change within apparent constancy. Vegetable mold is always the same, yet always changing. Each particle cycles through the system, beginning at the surface in a casting, spreading out, and then working its way down as worms deposit new castings above; but the mold itself is not altered. It may retain the same thickness and character while all its particles cycle. Thus, a system that seems to us stable, perhaps even immutable, is maintained by constant turmoil. We who lack an appreciation of history and have so little feel for the aggregated importance of small but continuous change scarcely realize that the very ground is being swept from beneath our feet; it is alive and constantly churning.

Darwin uses two major types of arguments to convince us that worms form the vegetable mold. He first proves that worms are sufficiently numerous and widely spread in space and depth to do the job. He demonstrates "what a vast number of worms live unseen by us beneath our feet"—some 53,767 per acre (or 356 pounds of worms) in good British soil. He then gathers evidence from informants throughout the world to argue that worms are far more widely distributed, and in a greater range of apparently unfavorable environments, than we usually imagine. He digs to see how deeply they extend into the soil, and cuts one in two at fifty-five inches, although others report worms at eight feet down or more.

With plausibility established, he now seeks direct evidence for constant cycling of vegetable mold at the earth's surface. Considering both sides of the issue, he studies the foundering of objects into the soil as new castings pile up above them, and he collects and weighs the castings themselves to determine the rate of cycling.

Darwin was particularly impressed by the evenness and uniformity of foundering for layers of objects that had once lain together at the surface. He sought fields that, twenty years or more before, had been strewn with objects of substantial size—burned coals, rubble from the demolition of a building, rocks collected from the plowing of a neighboring field. He trenched these fields and found, to his delight, that the objects still formed a clear layer, parallel to the surface but now several inches below it and covered with vegetable mold made entirely of fine particles. "The straightness and regularity of the lines formed by the embedded objects, and their parallelism with the surface of the land, are the most striking features of the case," he wrote. Nothing could beat worms for a slow and meticulous uniformity of action.

Darwin studied the sinking of "Druidical stones" at Stonehenge and the foundering of Roman bathhouses, but he found his most persuasive example at home, in his own field, last plowed in 1841:

> For several years it was clothed with an extremely scant vegetation, and was so thickly covered with small and large flints (some of them half as large as a child's head) that the field was always called by my sons "the stony field." When they ran down the slope the stones clattered together. I remember doubting whether I should live to see these larger flints covered with vegetable mould and turf. But the smaller stones disappeared before many years had elapsed, as did every one of the larger ones after a time; so that after thirty years (1871) a horse could gallop over the compact turf from one end of the field to the other, and not strike a single stone with his shoes. To anyone who remembered the appearance of the field in 1842, the transformation was wonderful. This was certainly the work of the worms.

In 1871, he cut a trench in his field and found 2.5 inches of vegetable mold, entirely free from flints: "Beneath this lay coarse clayey earth full of flints, like that in any of the neighboring ploughed fields. . . . The average rate of accumulation of the mould during the whole thirty years was only .083 inch per year (i.e., nearly one inch in twelve years)."

In various attempts to collect and weigh castings directly, Darwin estimated from 7.6 to 18.1 tons per acre per year. Spread out evenly upon the surface, he calculated that from 0.8 to 2.2 inches of mold would form anew every ten years. In gathering these figures, Darwin relied upon that great, unsung, and so characteristically British institution—the corps of zealous amateurs in natural history, ready to endure any privation for a precious fact. I was particularly impressed by one anonymous contributor: "A lady," Darwin tell us, "on whose accuracy I can implicitly rely, offered to collect during a year all the castings thrown up on two separate square yards, near Leith Hill Place, in Surrey." Was she the analogue of a modern Park Avenue woman of means, carefully scraping up after her dog: one bag for a cleaner New York, the other for Science with a capital S?

The pleasure of reading Darwin's worm book lies not only in recognizing its larger point but also in the charm of detail that Darwin provides about worms themselves. I would rather peruse 300 pages of Darwin on worms than slog through 30 pages of eternal verities explicitly preached by many writers; Darwin would certainly teach me more. The worm book is a labor of love and intimate, meticulous detail. In the book's other major section, Darwin spends 100 pages describing experiments to determine which ends of leaves (and triangular paper cutouts, or abstract "leaves") worms pull into their burrows first. Here we also find an overt and an underlying theme, in this case leaves and burrows versus the evolution of instinct and intelligence, Darwin's concern with establishing a usable definition of intelligence, and his discovery (under that definition) that intelligence pervades "lower" animals as well. All great science is a fruitful marriage of detail and generality, exultation and explanation. Both Darwin and his beloved worms left no stone unturned.

I have argued that Darwin's last book is a work on two levels—an explicit treatise on worms and the soil and a covert discussion of how to learn about the past by studying the present. But was Darwin really concerned with establishing a methodology for historical science, as I have argued, or did he merely stumble into such generality in his last book? I believe that his worm book follows the pattern of all his other works, from first to last: every compendium on minutiae is also a treatise on historical reasoning—and each book considers a different principle.

"HE PERCHED MOTIONLESS.
I HELD MY BREATH AND REACHED
FOR MY NIKONS...
NIKON 9X30
ROOF PRISM
BINOCULARS

...And suddenly it was as though I was next to him. I could make out every detail with incredible clarity and brilliance; the moist eyes, each feather stood out in startling detail. It was a moment I would never forget. I was glad I chose Nikons."

It's moments like these that make you glad you didn't settle for anything less than Nikon Binoculars. Their superb optics and uncompromising prism-lock construction are designed to give years of flawless performance even under the toughest conditions.

There are more than 20 Nikon Binoculars to choose from. See them at your Nikon dealer or write Nikon Inc., Dept. 26, 623 Stewart Ave., Garden City, N.Y. 11530.

Nikon

©1981 NIKON INC

NORFOLK BY THE SEA

The love affair has lasted for 300 years, a romance between a fascinating old city and the silver sea that surrounds her. Together they've known the flash of cannon fire and the birth of nuclear sub. They've produced great seafood and Grand Opera. Azaleas at water's edge, and harbor cruises on a moonlit bay.

Join us this year for our 300th anniversary celebration. For a free 40-page Visitors Guide, call toll-free 1-800-368-3097 or write Norfolk Convention & Visitors Bureau, Monticello Arcade, Norfolk, Va. 23510.

The 1982 Program

Stimulate your mind on a Questers nature tour. We search out the plants and animals, birds and flowers...and explore rain forests, mountains and tundra, seashores, lakes and swamps. There is ample time to photograph, absorb, reflect. Naturalist guides, small tour parties, first-class accommodations.

Worldwide Nature Tours 1982 Departures

The Americas

Everglades: 11 days, Apr. 8, Nov. 4 • **Hawaii:** 15 days, Feb. 14, Mar. 21, Oct. 10, Dec. 19 • **Alaska:** 17 days, June 12, 26, July 10, 24, Aug. 7 • **Pacific Northwest:** 12 days, June 20, Aug. 1 • **Superior Forest Canoe Trip:** 9 days, July 10, Aug 14 • **Northwest Canada:** 16 days, July 2 • **Churchill:** 11 days, July 17 • **Newfoundland:** 16 days, June 13 • **Baja California:** 11 days, Apr. 16, Oct. 15 • **Southern Mexico:** 14 days, Feb. 14, Dec. 19 • **Costa Rica & Panama:** 16 days, Feb. 13, Nov. 20, Dec. 18 • **The Amazon:** 17 days, Jan. 17, May 9, July 4, Aug 8, Oct. 10, Nov 14 • **Galapagos:** 15 days, Jan. 28, Apr. 22, July 15, Aug. 5, Oct. 28 • **Peru:** 23 days, July 17, Nov. 6 • **Patagonia:** 21 days, Nov. 6 • **Trinidad & Tobago:** 11 days, Mar. 8, Nov. 8.

Europe

Iceland: 16 days, June 11, July 2, Aug. 6 • **Islands/Highlands of Scotland:** 21 days, May 27, July 15, Aug. 19 • **Switzerland:** 17 days, July 16, Aug. 13 • **Greece:** 19 days, Mar. 29, Sept. 20 • **Spain:** 20 days, Apr. 16, Sept. 3.

Asia and Africa

Israel: 16 days, Mar 15, Oct. 18 • **The Himalayas:** 23 days, Mar. 18, Oct. 7 • **India:** 23 days, Jan. 30, Oct. 30, Nov. 27 • **Sri Lanka:** 18 days, Feb. 19, Nov. 19 • **Kenya:** 23 days, Feb. 4, July 22, Oct. 21 • **Zimbabwe & Botswana:** 19 days, July 8, Aug 5.

Australasia

Australia & New Zealand: 30 days, Feb. 13, Oct. 2 • **New Zealand & the Milford Track:** 22 days, Feb. 12, Nov 12 • **The Complete Australia:** 35 days, Sept. 3.

To learn more, write requesting the 1982 Directory of Worldwide Nature Tours. Indicate if you are interested in any particular tour and we will send the corresponding Detailed Itinerary.

QUESTERS

Questers Tours & Travel, Inc.
Dept. NH, 257 Park Avenue South
New York, NY 10010 • (212) 673-3120

Consider his first book on a specific subject, *The Structure and Distribution of Coral-Reefs* (1842). In it, he proposed a theory for the formation of atolls, "those singular rings of coral-land which rise abruptly out of the unfathomable ocean," that won universal acceptance after a century of subsequent debate. He argued that coral reefs should be classified into three categories—fringing reefs that abut an island or continent, barrier reefs separated from island or continent by a lagoon, and atolls, or rings of reefs, with no platform in sight. He linked all three categories with his "subsidence theory," rendering them as three stages of a single process: the subsidence of an island or continental platform beneath the waves as living coral continues to grow upward. Initially, reefs grow right next to the platform (fringing reefs). As the platform sinks, reefs grow up and outward, leaving a separation between sinking platform and living coral (a barrier reef). Finally the platform sinks entirely, and a ring of coral expresses its former shape (an atoll). Darwin found the forms of modern reefs "inexplicable, excepting on the theory that their rocky bases slowly and successively sank beneath the level of the sea, whilst the corals continued to grow upwards."

This book is about coral, but it is also about historical reasoning. Vegetable mold formed fast enough to measure its rate directly; we capture the past by summing effects of small and observable present causes. But what if rates are too slow, or scales too large, to render history by direct observation of present processes? For such cases, we must develop a different method. Since large-scale processes begin at different times and proceed at diverse rates, the varied stages of different examples should exist simultaneously in the present. To establish history in such cases, we must construct a theory that will explain a series of present phenomena as stages of a single historical process. The method is quite general. Darwin used it to explain the formation of coral reefs. We invoke it today to infer the history of stars. Darwin also employed it to establish organic evolution itself. Some species are just beginning to split from their ancestors, others are midway through the process, still others are on the verge of completing it.

But what if evidence is limited to the static object itself? What if we can neither watch part of its formation nor find several stages of the process that produced it? How can we infer history from a lion? Darwin treated this problem in his middle book, his treatise on the fertilization of orchids by insects (1862), which followed the *Origin of Species*. I have discussed his solution in several columns and will not dwell on it here: we infer history from imperfections that record constraints of descent. The "various contrivances" that orchids use to attract insects and attach pollen to them are the highly altered parts of ordinary flowers, evolved in ancestors for other purposes. Orchids work well enough, but they are jury-rigged to succeed because flowers are not optimally constructed for modification to these altered roles. If God wanted to construct insect attractors and pollen stickers from scratch, he would certainly have built differently.

Thus, we have three principles for increasing adequacy of data: if you must work with a single object, look for imperfections that record historical descent; if several objects are available, try to render them as stages of a single historical process; if processes can be directly observed, sum up their effects through time. One may discuss these principles directly or recognize the "little problems" that Darwin used to exemplify them: orchids, coral reefs, and worms—the middle book, the first, and the last.

Darwin was not a conscious philosopher. He did not, like Huxley and Lyell, write explicit treatises on methodology. Yet I do not think he was unaware of what he was doing, as he cleverly composed a series of books at two levels, thus expressing his love for nature in the small and his ardent desire to establish both evolution and the principles of historical science. I was musing on this issue as I completed the worm book two weeks ago. Was Darwin really conscious of what he had done as he wrote his last professional lines, or did he proceed intuitively, as men of his genius sometimes do? Then I came to the very last paragraph, and I shook with the joy of insight. Clever old man; he knew full well. In his last words, he looked back to his beginning, compared those worms with his first corals, and completed his life's work in both the large and the small:

> The plough is one of the most ancient and most valuable of man's inventions; but long before he existed the land was in fact regularly ploughed, and still continues to be thus ploughed by earthworms. It may be doubted whether there are many other animals which have played so important a part in the history of the world, as have these lowly organized creatures. Some other animals, however, still more lowly organized, namely corals, have done more conspicuous work in having constructed innumerable reefs and islands in the great oceans; but these are almost confined to the tropical zones.

At the risk of unwarranted ghoulishness, I cannot suppress a final irony. A year after publishing his worm book, Darwin died on April 19, 1882. He wished to be buried in the soil of his adopted village, where he would have made a final and corporeal gift to his beloved worms. But the sentiments (and politicking) of fellow scientists and men of learning secured a guarded place for his body within the well-mortared floor of Westminster Abbey. Ultimately the worms will not be cheated, for there is no permanence in history, even for cathedrals. But ideas and methods have all the immortality of reason itself. Darwin has been gone now for a century, yet he is with us whenever we choose to think about time.

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

Living well is the best revenge.
B and B. A blend of Benedictine and fine Cognac.

© 1980 JULIUS WILE SONS & CO. IMPORTED FROM FRANCE 80 PROOF.

Squid Swarm

Schools of squid mass off the California shore in a rite of reproduction. A host of predators find the cephalopods easy pickings

Photographs by Jeff Foott

Eat, spawn, and be eaten. That simple scenario probably best describes the short, frenetic terminal period during which the squid *Loligo opalescens* performs its mating ritual. Enacted off the coasts of California, this ritual is one of nature's spectaculars.

In the waters surrounding Santa Catalina Island (where these photographs were taken), millions upon millions of these ten-tentacled cephalopods, in equal numbers of males and females, congregate from mid-November until the end of April. They come to this specific area every year to spawn and die.

Spawning marks the end of a three-year life cycle that began when the squid, a scant 5 mm in length, hatched from their egg cases on the ocean bottom. Soon after hatching, the young squid swim upward until they reach the surface, away from the spawning grounds. They join the plankton community, and at this vulnerable stage, the squid are preyed upon by ctenophores, arrow worms, siphonophores, and other plankton-eating animals. They still receive nourishment from internal yolk sacs, but rapidly assume their roles as voracious predators. Virtually anything their own size is fair game.

Predators and prey descend to deeper levels as they grow in size. Coastal currents disperse the squid over a wide area, and they grow longer as the number and size of the prey they consume becomes larger. Constantly on the move, squid are among the fastest swimmers in the ocean. Their metabolic rate is high, and they require large amounts of food to meet their energy needs. The squid now forage from the sea surface to the floor. Crustaceans are an important food item, and sardines, herring, mackerel, and anchovies are frequently attacked and eaten. Cannibalism is common: fellow squid constitute up to 25 percent of the diet of young *L. opalescens*.

The squid are of great importance in many pelagic food chains. As predators, they crop a wide variety of prey; as prey, they provide food for a large assortment of fish, sea mammals, and birds. A partial listing of squid-eating predators includes dogfish, ratfish, salmon, lancet fish, hake, sea bass, mackerel, bonito, albacore, lingcod, halibut, and tuna, the toothed whales and porpoises, sea lions, harbor seals, sea otters, and gulls.

At approximately the age of three, the squid have attained a maximum size of six inches. This stage marks

the onset of squid sexual maturity, and the urge to mate is manifested by migrating to traditional spawning grounds in such numbers that the sea seems aboil. Males are normally palish white, but their heads and tentacles turn dark maroon as their sexual urge drives them to mate in promiscuous fashion. The nighttime scene is one of countless males embracing females and passing packets of sperm into the mantles of their mates with a specialized tentacle. After fertilization, females swim to the bottom in search of suitable anchoring sites for their eggs, which are laid in filamentous strands. Many such strands are laid together by different females until they resemble mops. The ocean floor is littered with billions of squid eggs, which upon hatching, become the new generation of *L. opalescens*.

The adult squid, spent from the frenzy and activity of mating, and physically damaged in the process, fade into death. Predators across the spectrum now move in to crop the resource. Squid for the human table is also harvested at the time of spawning. In a matter of a few days, the squid, through their act of procreation, have provided sustenance for other life forms in the sea, in the air, and on land.

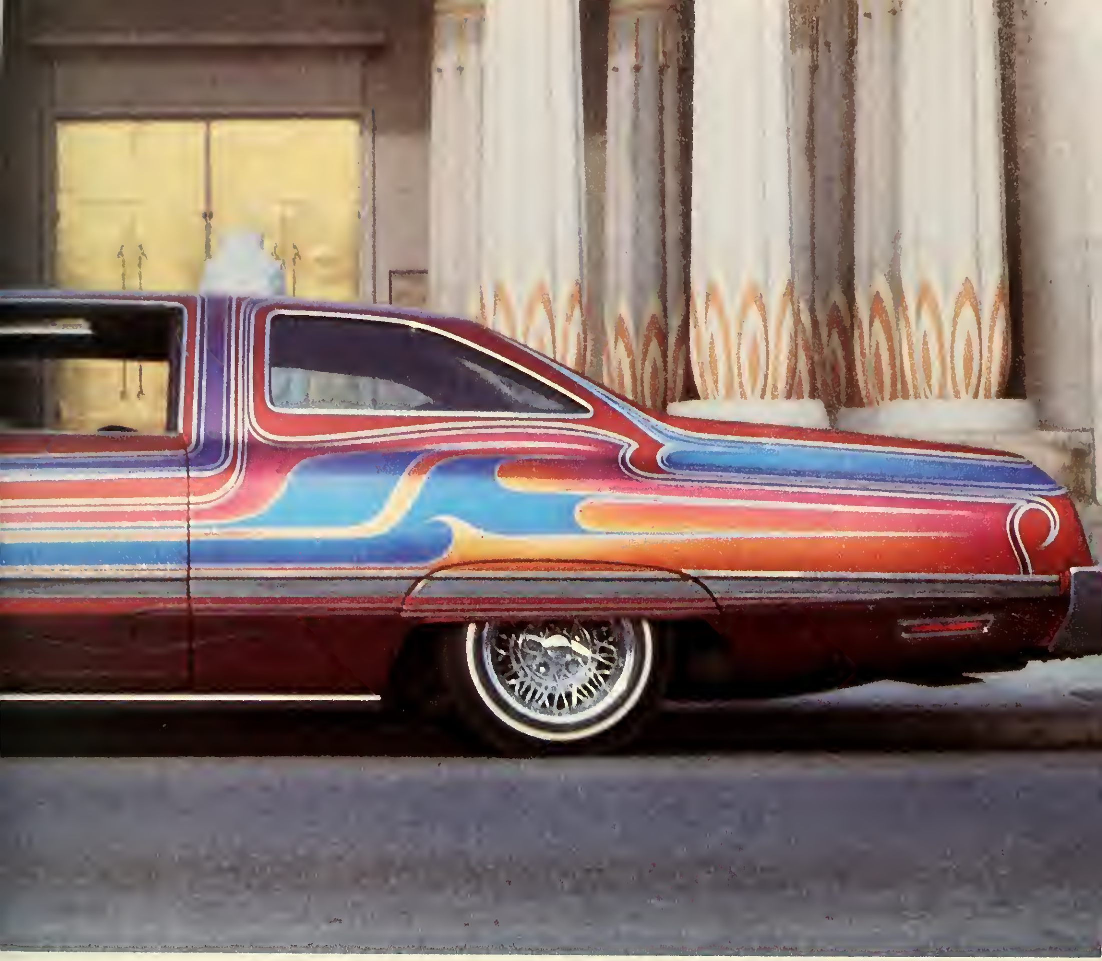
Low and Slow, Mean and Clean

For cruising "low riders," the destination is less important than the presentation of a new image for the Mexican-American

by William Gradante

While the hot rodder jacks up his car, replaces his stock wheels with wide "mags," and races recklessly about town at breakneck speed, the low rider's preference is low and slow. Undersized tires, shortened suspension coils, even a hydraulically powered suspension, lower the automobile body, and fifteen miles per hour in the city may be considered brisk by the low rider. He has invested a great deal of time, money, and effort in his "ride" and prefers to cruise along at a pace that allows him to show it off—to other low riders, to curious and occasionally outraged Anglo-Americans, and to the lovely Latin ladies who pass by, pretending not to notice.

Although the terms *low rider* and *low riding* have only recently found their way into the lexicon of American mass culture, for several years they have cir-



Larry Gonzalas

Parked in front of the Egyptian Museum in San Jose, California, a low rider's 1974 Chevrolet Caprice boasts an electric sunroof, handleless "pop" doors, and a twelve-color candied and metal-flake paint job executed by the owner.

culated in various sectors of the media, from community-oriented Mexican-American newsletters and *Low Rider*, a California-based monthly magazine, to Top Forty 45-rpm recordings and the pages of the *New Yorker* magazine. Low riding itself has been an integral and highly visible part of Mexican-American popular culture for the Chicano and the *vato loco* ("crazy dude") of the barrio, as well as the Mexican-American suburbanite, since at least the early 1950s. While remaining primarily recreational in nature, low riding and all of its accompanying activities have become a means by which an increasing number of Mexican-Americans seek to alter the image of poverty and neglect attached to their ethnic group.

Although not limited to Mexican-Americans, low riding originated as a conscious rebellion against the stereotypic hot-rodding middle-class Anglo-American of the 1940s and 1950s. Low riding seems to be centered in California, particularly in the East Los Angeles and San Jose areas, but it is also spreading in Texas, Arizona, New Mexico, and to a lesser extent, Colorado and some midwestern states with large Mexican-American populations. Apparently, relatively few Hispanic Americans of non-Mexican origin are interested in low riding, although a small but growing number of Anglo-Americans and blacks have become involved.

Through their driving habits, the low riders project the image of the safe, energy-conserving, law-respecting citizen, while simultaneously contrasting what they see as the relaxed, leisurely paced life style of the Latino with the hurried and often overly time-conscious mode of the Anglo-American. In the Fort Worth-Dallas Metroplex area where I did my research, low riders have frequently been ticketed for "excessive slowness," while overzealous policemen in Eagle Pass, Texas, have been known to ticket caravaning low riders for not having parade permits. In 1979 low rid-

LIFESTYLE
LOS ANGELES
ROBERTS
DISCOUNT
BARRY'S JEWELERS
BETTY

Gregory Heisler; Liaison

A mural of East Los Angeles's Whittier Boulevard decorates Leonard Diaz's "Crazy Camino."

ers across the Southwest were extremely gratified when it was rumored that President Carter had declared April 1–7 "National Low Rider Week," on the grounds that low riders are both safe drivers and extremely economical and patriotic in terms of their low fuel consumption and their choosing to drive American-made cars, exclusively.

In Grand Prairie, Texas, a council of low rider club presidents recently arranged to meet with local law-enforcement agencies with the object of educating patrolmen about the goals and community contributions of their clubs and dispelling the mistaken notion that they are gangs engaged in antisocial behavior. In fact, only in the last two or three years has the Mexican-American population as a whole become fully aware of the positive role that low riders play in their community. In addition to raising funds for various charitable causes (such as the associations for muscular dystrophy and multiple sclerosis), Metroplex low rider clubs have been active in the local *operación juguete* (toys for tots) campaign and have begun to work closely with area chapters of the nationally prominent League of United Latin-American Citizens (LULAC). The low riders' current project is encouraging community members to register and vote and was initiated in conjunction with LULAC. It includes setting up convenient registration centers and providing free (but slow) transportation to these centers and to the polls at election time.

Beto Salazar, president of a local low rider club and an enthusiast since 1954, remembers the 1950s as an era when cars were lowered by piling bricks or bags of sand into the trunk. Today's low rider patiently awaits the day when he can afford a hydraulic system to "lift" his car in the front or rear, or "juice it all around." At the flick of a toggle switch, a 3,000-pound automobile can be made to rest its frame on the asphalt or "hop" to legally acceptable heights upon the arrival of a police officer. The motor vehicle laws of the Texas Department of Public Safety state that no portion of a motor vehicle may ride lower than the lowermost portion of the wheel rims, so most Metroplex low riders are meticulous in their work on their suspensions. They are careful not to break the law and run the risk of a $33.50 ticket, but they are equally concerned not to drive any higher than is absolutely necessary.

"Low and slow, mean and clean" is the low rider's slogan. It is not enough to have a lowered car in which to drive slowly. The car must be "bad," "mean," it must be "clean," it must have "class." These are but four of many terms low riders use to describe a beautiful car. One of the central activities of the low riders' Sunday get-together in Fort Worth's Trinity Park is car waxing—a clean ride is always "waxed to the max." Salazar is quick to point out that his car is not only literally clean but also immaculate in that it is a work of art, a moving symbol of his personal dignity and pride in himself, his family, his club, and his heritage as a Texas-Mexican. Low riders are in no way ashamed of their generally lower- to lower-middle-class backgrounds and are rightfully proud of their hard work ethic. As Teen Angel, staff artist and feature writer for *Low Rider*, has stated,

> We relate to cars that are close to the gound because they are bad. Hey, anybody can go finance a new car. But not every-

> body can find a bomb and fix it up. It takes a little talent, time, patience, bloody knuckles, greasy levis, and feria [money]. But mostly work. And the more you work, the less you get into trouble. The more you work, the nicer your ride becomes. I respect people like that. Work hard and create something beautiful and a little different from everyone else's ride.

Teen Angel expresses the feelings of nearly all low riders when he writes, "You love a car more when you work on it personally." In the Metroplex area there are only a few low riders who perform all of the varied tasks in customizing their rides from start to finish, but most do the majority of the work or exchange special skills. In addition, they are proud that, unlike many customized "show" cars, their cars are not extra cars, not exclusively show cars, but are driven daily—to school, to work, to church, and for cruising.

Salazar notes that early low riders identified their cars as family vehicles by hanging a pair of baby shoes from the rearview mirror. A steady girlfriend's necklace, bracelet, religious medallion, or kerchief would often occupy this place of honor in a single man's car, while nearly all drivers kept a Saint Christopher medal draped over the sun visor and a small statue of the Virgin of Guadalupe, Mexico's patron saint, on the dashboard. While the religious artifacts remain today, "fuzzy dice" or bandannas have largely replaced other objects hung from the rearview mirror. Even the most dedicated low riders I interviewed did not attach any significance to the dice, but the bandannas are part of typical low rider attire.

Presented below is a list of the kinds of things that a low rider will do to make a class ride out of an old bomb, and the price he would normally have to pay to have such work done for him:

Lower the suspension by removing approximately one-half of each suspension coil	$150
Replace standard tires with small ones, generally sizes 5.20 or 5.60	$150
Replace wheels with Tru-Spoke wire wheels	$760
Replace steering wheel with one made of welded, chrome-plated chain in either 6-, 8-, or 10-inch diameter	$30
"French in" (recess into the body) a set of electric antennas	$120
"Juice it all around," that is, apply hydraulic pumps to both front and rear ends	$2,000
Add chrome in the form of a pair of dummy spotlights, or "dummies," and a pair of dummy exhaust side pipes	$150
Remove the outer door handles for a "shaved" look (these "pop doors" are opened with a concealed switch)	$200
Total	$3,560

We've already seen more than $3,500 spent, and the best parts are yet to come! Most low riders attempt to do their interiors in crushed velvet if they can afford it. The interior includes the seats—which may all be swivel-seats—the ceiling, dashboard, floor, inside the doors, and the trunk. Depending upon whether a chandelier, stereo, television, or a bar is to be included, the cost can run into the thousands. In addition to the lavish décor of the interior, there are the hand-painted murals on the hood, roof, or trunk, and the etching done on the window glass. These finishing touches depict scenes from contemporary Mexican-American culture.

Before any mural can be painted, the automobile must have a finished paint job. Many low riders use acrylic enamel paint, the standard paint applied by major auto manufacturers, as it costs only about $400 to $500 to have the job done. Metroplex low riders seeking a really class finish will get an acrylic lacquer paint job. There are three choices in this category—metal flake, pearl, or candied—each applied by the same basic process.

Metal flake finish
1. 5 coats of any color lacquer
2. 3 coats of clear lacquer, mixed with any color metal flake (to create a metallic effect)
3. 8 coats of clear lacquer

Pearl finish
1. 5 coats of any color lacquer
2. 3 coats of clear lacquer, mixed with any color powdered "mother-of-pearl" additive (to create a rainbow effect)
3. 8 coats of clear lacquer

Candied finish
1. 5 coats of silver or gold lacquer
2. 3 coats of clear lacquer, mixed with a candy color lacquer (to create a glasslike layer, reminiscent of a candied apple)
3. 8 coats of clear lacquer

This type of paint job generally costs about $1,000; some cars are covered with multicolored geometric designs, which may take a month or more to execute, at a cost of more than $2,000. Murals, which cost somewhere between $300 and $500, are normally painted by

Low riders cruise in a slow caravan through East Los Angeles.

Jesse L. Alexander

contracted specialists and are applied between the second and third stages. Many Metroplex low riders spend another $150 to $200 to add pinstriping designs to the doors, hood, and trunk.

The artwork on a low rider car is created for an audience consisting of spectators at a low rider car show, or "happening," and motorists and pedestrians who encounter the low rider as he cruises. Low riders are aware that they are a highly visible element of the Mexican-American community and that they and their vehicles project the community's values to American society as a whole. The window etchings and full-color murals on the automobiles, as well as the commercially produced low rider T-shirts worn by schoolchildren and club members alike, reflect the community that spawned low riding.

At the Second Annual Metroplex Low Rider Happening in June 1981, the window etchings illustrated a wide variety of themes. A common design featured a Mexican girl with *Mi Vida* ("my life," or more broadly, "my reason for living") inscribed on a banner, often with the name of the low rider's girlfriend, wife, or daughter. Another depicted a Mexican *charra* ("cowgirl") wearing a wide sombrero. A portrait of the Virgin of Guadalupe decorated one car, which faced another bearing a scene in which a low rider, leaning on a lamppost, casually asks a foxy Chicana, *¿Y qué?* ("what's happening?"). Other etchings included a solitary low rider in front of his ride, a pair of low riders greeting each other with the Chicano handshake beneath a banner that proclaimed *Chicanos Unidos* ("Chicanos United"), and a portrait of La Indita, a Mexican Indian maiden. One of the more impressive windows was inscribed with the following:

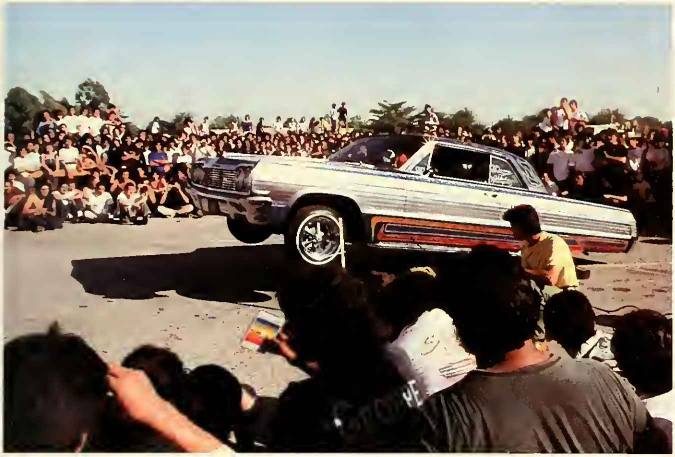
> Christians by the grace of God
> Gentlemen thanks to our Spanish
>   descent
> Noble lords from our Indian ancestry
> Mexican by pride and tradition
> And American by destiny
> Thus we are the Mexican-Americans

Owing to their high cost, as well as to the scarcity of local artists proficient in the medium of automobile painting, murals were not as common as window etchings. Among those displayed at the Second Annual Metroplex Low Rider Happening were a suffering Christ figure, a sunset view of the San Antonio skyline, and several portraits of Aztec princesses and warriors.

559 RGX
CHEVROLET

Larry Gonzales

Larry Gonzales



Above: At an East Los Angeles low rider car show, or happening, a 1964 Chevrolet Super Sport competes in a hopping contest, using its hydraulic suspension system to bounce the front end high off the ground. Left: A 1954 Chevrolet Bel Air from Stockton, California, displays its candied finish and Continental spare at a Fresno happening.

The more active Metroplex low rider clubs cruise hundreds of miles nearly every month to happenings around the state and spend an enormous amount of time preparing for the Annual Metroplex Low Rider Happening. The low riders' other activities, such as the weekly outings, cruising caravans, charity fund-raising efforts, and barbecues, while significant and exciting in themselves, do not feature the qualities of performance that are the essence of the low rider happening. Beto Salazar recalls his early days as a low rider in Crystal City, Texas, when the only low riding competitions were held in the parking lot of the local Dairy Queen. A pack of Camel cigarettes was placed upright on the ground and the driver, his trunk full of bricks or sandbags, attempted to cruise directly over it. Only the lowest rides achieved the feat of tipping over the pack. In contrast, today's low rider happening is a large-scale event during which the most striking aspects of low riding are presented in spectacle form.

There is literally something for everybody. Trophies are awarded for first-, second-, and third-place honors for automobile models for each decade from the 1930s to the present. (The straight lines of the 1963 Chevrolet Impala make it an especially popular model in the Metroplex area.) Single awards are made for the best interior, paint job, mural, and window etching. For the youngsters, there are trophies given for plastic model cars and for low rider bicycles. Teen-age girls compete in modified zoot suits for "Bad Girl" honors, and everyone joins in a 1950s dance contest. At the 1981 happening, a local radio station and the distributor of a well-known soft drink cosponsored a Cheech and Chong Look-alike Contest, but several club members expressed their disapproval, owing to the strongly drug-oriented humor of this comedy team.

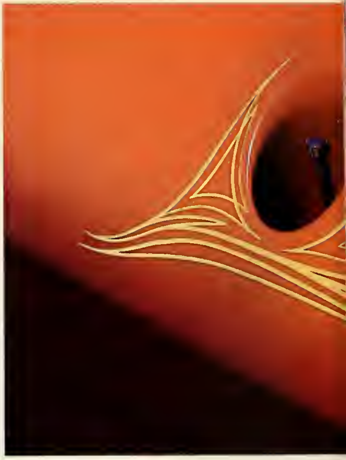
The only event in which cash prizes are offered is also the most unusual: using a hydraulically powered suspension system to bounce the front end of a car high off the pavement. Writing in *Road and Track* magazine, Cissy Steinfort remarks:

> Making cars hop was discovered accidentally, some observers say. When hydraulics are juiced by several batteries, cars have a natural tendency to jerk up. It followed that someone would capitalize on this novelty, crossing the macho instinct with the magic appeal of a single driver having the power to hop a 3000-plus-lb car with the push of a button. It's called "hopping," but it's really less like a bunny than like a heart attack victim being jolted back to life by electric defibrillators.

In competition hopping, what counts is the distance from the pavement to the bottom of the front tires, although the rear tires may also leave the ground a couple of inches. In Fort Worth a prize of $500 was given to the winner of the 1981 Single Pump Hopping Contest for a hop of more than twenty inches. The world's record is believed to be held by Ralph "Rag Top" Carrillo of Norwalk, California, who has hopped the front end of his 1963 Chevrolet Impala more than twenty-nine inches. In California happenings, professional hoppers such as Carrillo, as well as Texans Lui LaFuente and Oscar "The Mad Hopper" Yánez, have earned as much as $2,500 for first-place honors in this event. The big prizes are offered to attract such "name" cars.

While either the front or rear end of a car can be juiced by means of a hydraulic system powered by two large batteries, ten such batteries, heavy-duty springs, and a high-capacity pump are

Teri Sandison, After-Image



Above: Custom pinstriping enhances a door handle and a pair of "Frenched in" (recessed) electric antennas. Right: Willie Gamez of San Antonio, Texas, shows off his 1965 Chevrolet Super Sport, whose chrome spotlights and side pipes are nonfunctioning decorations.

necessary to create today's hopper. The three-way toggle switch that controls the hydraulic mechanism is located anywhere on or beneath the dashboard. Normally, the switch is in the "off" position. When it is held in the "pump" position, hydraulic fluid is pumped from a reservoir into the cylinders, raising the automobile's A-frame. When the switch is held in the "dump" position, the fluid is pumped into the reservoir, lowering the A-frame. If the switch is turned on to pump the car all the way up and then immediately thrown to "dump," the entire body of the automobile is sent crashing to the pavement. The knowledgeable driver uses especially narrow tires and overinflates them to between seventy and eighty pounds of pressure. This makes the car bounce upward upon impact with the pavement. By dexterously flicking the toggle switch to "pump" again at the precise instant that the bounce begins, the driver can increase the height of the hop by the addition of the hydraulic lifting motion.

Compared with a pump used simply to raise and lower the front or rear of a car, the pump in a hopper is larger and more powerful. The hydraulic fluid res-

Tom Story

ervoir and the ducts through which the fluid flows are also larger, so a great volume of fluid can be moved in a small amount of time. For competitive purposes, the front end must be equipped with only one pump, which is sufficient to make a car hop, but having a rear hydraulic system as well allows for much greater power and upward thrust. Any number of batteries are permitted to power a pump, although more than six would be apt to burn it out. In competitions, ten batteries (six for the front, four for the rear) are usually stacked side by side in the trunk, while the driver operates the toggle switch from outside the car by means of a cable release. This weight distribution contributes to hopping capability. In the early 1970s, when hopping was in its infancy, there were no rules governing the contests and participants resorted to schemes that included filling the rear bumper with lead and removing the front bumper or even the engine to lighten the front end. Today, owing to the efforts of low riders interested in standardizing the rules of competition and measurement, hopping has acquired the status of a full-fledged sport.

Among California low riders, "throwing scrapes" has become another popular activity, culminating in Hop and Scrape contests with prizes of as much as $2,500 in each category. To throw a scrape, a driver merely drops the front end of his car to the pavement using his hydraulic system. A metal "scrape plate," approximately a foot long and two inches wide, welded to the front end of the chassis, sends a shower of sparks in all directions. In competition, the

Larry Gonzales

driver throwing the longest scrape is declared the winner. When cruising, scrapes and hops attract attention to the low rider and his ride.

Most Metroplex low riders do not believe in throwing scrapes, however, because the body of the car must be lowered beyond the limits declared by Texas law. The presidents of nearly all Metroplex low rider clubs agree that destroying state property—pavement surfaces—or breaking the law is not acceptable behavior by club members. As a result, there has been some discussion about purchasing a small piece of land on which a private scraping strip might be built expressly for this purpose. Until this becomes a reality, however, northern Texans can expect to see little scraping action.

The low rider happening is a showcase for the various artistic and recreational activities of the low rider culture, reaching the larger community as well as younger and more inexperienced low riders. As representatives from area automotive equipment businesses explain the advantages of their unique products, many of the more respected low riders take time to instruct the uninitiated. This ranges from explaining to youngsters various ways to produce customized effects in their models to demonstrating airbrush painting techniques in small-scale murals.

Frank García of the Low Relations club claims that one of his greatest satisfactions is to encounter the curious non–low rider—particularly the Anglo-American—as it is one of very few situations in which he can interact in a positive manner with "white people." "When they see my ride, they know I'm a hard worker and a serious and responsible person, because they know I've put a lot of time and money into it." Where the infamous pachuco of 1930s and 1940s Los Angeles emphasized his nonconformity for the sake of rebellion, the low rider enthusiastically shares his cultural heritage and mechanical and artistic creativity with the American majority culture. He does this without abandoning the values of his community.

While the happening is its most spectacular aspect, the strength of low riding, *Tejas* style, lies in organization and a positive attitude. In the Fort Worth-Dallas Metroplex area there are between twenty and thirty low rider clubs, the older clubs generally having the most formal rules and regulations. Most low riders in the Metroplex area agree that Los Bajitos de Grand Prairie, Tejas (The Low Ones of Grand Prairie, Texas), is currently the leading force in area low riding. The club's motto is "People Helping People," and the club president, Beto Salazar, says it is "a family-type organization trying to help *la raza* [the race, Mexican-Americans]."

The club maintains a written set of bylaws, violation of which constitutes grounds for expulsion, temporary suspension of membership privileges, or a small fine. For example, tardiness draws a $3 fine and an unexcused absence from a meeting costs $5. A second such

Larry Gonzales

Stephenie Maze; Woodfin Camp & Associates

Left: In Pomona, California, model Mona Vargas shows off a Chevrolet Camaro interior that was done by the car's owner. The welded chain-link steering wheel is a popular feature among low riders. Above: At a happening in Fresno, Chevrolets from the late 1940s and early 1950s are proudly displayed.

absence is punished by permanent expulsion from the club. Failure to wear the club T-shirt to meetings draws a fine of $2.50, and speaking out of turn, a half dollar. Disorderly conduct during a cruise leads to a $10 fine and an official, written warning. A second such breach results in permanent expulsion. A great deal of emphasis is placed on using the democratic process in the annual election of officers, the acceptance of new members, and in all decisions concerning club activities. New members are selected according to rules outlined in the "Bajito Charter": a prospect's seriousness about low riding is examined in terms of his work on his car, his demonstrated desire to participate regularly in weekly club activities on both local and state levels, and his ability and willingness to assist in the club's many community-oriented projects. These range from general promotion of low rider values and techniques to volunteer work with Mexican-American youngsters from low-income areas and fund raising for local charitable organizations. For example, in 1981 Los Bajitos sponsored a little league soccer team in Grand Prairie and helped raise funds for the Fort Worth Youth Mariachi music program, among other things.

At present, Los Bajitos de Grand Prairie has twenty-eight members and twenty finished cars. By contrast, Frank García's Low Relations club of Fort Worth's South Side has no formally established rules and only six members, including Frank, his two brothers, and his brother-in-law. Nevertheless, this is a very respected club, made up of mature individuals capable of mobilizing support for, and following through on, community projects. Low rider clubs in the Metroplex area tend to form on the basis of the age and the marital status of the members, as well as their neighborhood affiliations. These divisions do not lead to intergroup rivalries, however. Cruising activities in Fort Worth, for example, frequently take place in the centrally located Trinity Park area, where a sense of community among low riders is clearly growing. While these Sunday afternoon gatherings provide the context for considerable courtship activity among teen-agers, the overall function of the picnics, barbecues, and softball games is one of community socializing and family recreation.

Los Bajitos de Grand Prairie meets at 1:00 P.M. on the first Sunday of each month. Following the official meeting in which club business and future endeavors and shows are discussed and planned, the cruising begins. The predetermined route, usually to a local park or, as Beto Salazar says, "wherever the people are," is outlined in advance. As president, Salazar leads the caravan, each car—*carrucha* or *ranfla*—following at least one car-length behind. On city streets the pace is about twenty miles per hour while on interstate highways they move at between thirty and forty miles per hour. Each driver is responsible for following the driver in front of him, checking to make sure that the driver behind him does the same. No hopping or scraping is allowed while on the public roadways, but upon arrival at the destination some stationary hopping will take place. There is normally a barbecue, paid for by the club's treasury (monthly dues are $5), and often a *piñata* for the children. Members discuss the recent progress in their work on their cars, admiring each other's workmanship and making suggestions for further improvements. At dusk, Salazar leads the caravan back to town or to a popular taco stand. At this point, the day's activities officially draw to a close, and members are free to return home.

In a 1978 article in the *New Yorker*, Calvin Trillin and Edward Koren pointed out that car clubs began to emerge in Los Angeles in the early

William Gradante

Pete Antillôn of Dallas's Los Únicos car club estimates he put $10,000-worth of labor and parts into "Pete's '39," including a modern engine (the car has since been sold).

1950s and were strongly encouraged by community workers. (Beto Salazar speculates that low riding may have been brought to California by migrant farm workers from Texas.) Low riding today enjoys its greatest popularity in California. The *New Yorker* article also stated that car clubs were not territorial and that the members did not live *la vida loca* ("the wild life," "the crazy life"). In this sense, *la vida loca* refers to the violent and irresponsible life style of the pachucos of East Los Angeles in the late 1930s through the 1950s. Among Metroplex low riders, however, the term describes the social or purely recreational aspects of contemporary low riding.

That the positive values of today's low rider clubs have replaced the violence and intergroup hostility of the gangs of decades past is shown in the names chosen by the members for their clubs. Writing in *Low Rider*, Sonny Madrid observes that these names "vibrate sophistication rather than 'macho violence' of the club names of yesteryear, such as the Jackson Kings, Night Intruders, Lords, Barons." In addition to the two already mentioned, other Metroplex low rider club names are: Street Life, Los Renacidos ("The Reborn"), Los Clásicos ("The Classics"), Los Buenos ("The Good Ones"), The Royal Classics, Los Muestros ("The Shows"), Street Players de East Dallas, and the Dallas Cruisers.

The low rider does identify positively with the past, however. When he wears a zoot suit today, he does so with a sense of pride in his cultural heritage, combined with the bitter memory of how dearly the wearing of the zoot suit cost his predecessors nearly forty years ago. Pachuco was used to describe the zoot-suited Mexican-American youth of the 1930s to 1940s in Los Angeles. The more salient features of his zoot suit, or "drapes," as the pachuco called it, were its wide shoulders and its baggy, high-waisted trousers with tight cuffs at the ankles. A wide-brimmed hat and heavy shoes completed the outfit. Carey McWilliams, a newspaper reporter in Los Angeles at that time, noted in his book, *North from Mexico:*

> There is nothing esoteric about these "sharp" sartorial get-ups in underprivileged groups. . . . They are often used as a badge of defiance by the rejected against the outside world and, at the same time, as a symbol of belonging to the inner group.

The zoot suit was also a symbol of rebellion against the historically low status of the ethnic group.

In the late 1930s and on through the 1940s, wearers of zoot suits were stereotyped by Anglo-American society as gangsters, social misfits, or as the Los Angeles newspapers described them, "zoot-suited roughnecks," people "of subversive character," "zoot-suited miscreants," "morons," and "zoot suit hoodlums." From June 3 to 9, 1943, the East Los Angeles Mexican-American community was invaded by uniformed American sailors and soldiers determined to beat up any zoot suiters they could find, destroying their clothing in the process. The initial reaction of American society and its press was one of wholehearted approval. The newspapers of the day insinuated that the zoot suiters were a dangerous foreign element that should be rooted out from within our borders. The Los Angeles police, McWilliams reports, did not attempt to stop the attacks on innocent members of the East Los Angeles Mexican-American community. Rather, they waited until the servicemen had thoroughly beaten their victims, and then arrested the victims for disturbing the peace or on "suspicion of . . ." charges. History has since shown that the affair was, in fact, a large-scale race riot, and the zoot suit has become symbolic of the status of the oppressed Mexican-American community, as well as a sign of its solidarity against future aggression.

For the low rider, wearing a zoot suit, complete with suspenders and long watch chain, is generally reserved for the more formal low riding affairs, such as happenings. The daily wardrobe of most low riders is that of the *cholo*, as described in the *New Yorker*:

> In East L.A., gang members are now called cholos rather than pachucos. Their customary outfit now consists of stiffly starched khakis or dungarees, a white T-shirt, a plaid Pendleton shirt worn as a jacket, and a watch cap or a small-brimmed porkpie or a headband. . . . The cholo style of dress is derived largely from prison clothing.

While Metroplex low riders are not members of gangs, they do maintain the term *cholo*, along with the associated style of dress. *Cholo* literally means "mestizo," or "of mixed blood," but it is also used—particularly in the diminutive form, *cholito* or *cholita*—as a term of endearment for loved ones. To the contemporary Mexican-American it simply refers to one who customarily uses this style of dress. There is no desire to cultivate the image of the Mexican-American as a prisoner, an antisocial element, but rather, to give a new interpretation to styles worn by Chicanos in an era when they could afford little else. Important ingredients in the contemporary *cholo* look are the commercially distributed T-shirts bearing club names, photographs of classic automobiles, portraits of a suffering Christ, and colorful scenes of *cholos* and zoot suiters, featuring slogans such as *Carnales Unidos* ("United as Brothers"). One T-shirt depicts the Virgin of Guadalupe as the patroness of the low riders; her arms embrace an East Los Angeles cruising scene, with the slogan "Cruisin[g] Together."

The low rider spends quite a bit of money on his *cholo* outfit and accessories and, in most cases, must have his zoot suit made on special order. While the dress codes of the zoot suiter and *cholo* once contributed to a negative stereotype, the low rider has gradually created a positive image for the wearer. The low rider style of dress has even become the primary one for Mexican-American youth, beginning with pre-teen-agers in low rider theme T-shirts, Pendletons, and bandannas, to high school students in goatees, khakis, mirror sunglasses, two-tone wing-tip shoes, and porkpie hats (*tapitas*). The low rider's hope is that through his constructive actions and positive attitude, the American majority culture will eventually begin to look beyond the level of clothing and attempt to see the man beneath.

A low rider who owns a class ride is, by extension, a "class guy," or a *vato de aquellas*, someone respected by everyone. But class goes much deeper. In the 1940s, the pachuco spent every hard-earned penny on a class outfit, a zoot suit, because the sloppily dressed farm worker simply did not make it. The Anglo servicemen destroyed innumerable zoot suits, but they could not destroy the pachuco. Similarly, the outlawing of low riding or destruction of all the class cars would not take the class out of the low rider because he is not simply the owner of a fancy car. The community orientation and emphasis on interbarrio, intercity, interracial, and intergenerational cooperation and progress has made the low rider himself a "class act." ☐

CHEVROLET
Pete's 39
CHEVROLET

Chrysler LeBarons as shown: Sedan **$8,712;*** Coupe **$8,618.***

Chrysler Cordoba as shown: **$9,566.***

Chrysler New Yorker as shown: **$11,391.***

THE NEW CHRYSLERS

We've re-engineered the American luxury car.

The Chrysler LeBaron Series. They are like no other cars in America, Europe or Japan.

No other six-passenger car combines the high mileage, luxury and unexpected price of the surprising LeBaron coupe and sedan.** They stand alone.

LeBaron is built in one of the world's most technologically advanced plants. Computer-directed robots assure precision welding, and along with special sound insulation this accuracy helps make LeBaron a car of unusual quality and quietness on the road.

With advanced front-wheel-drive and a refined suspension system, LeBaron assures sure-footed traction, cornering and a sense of confidence behind the wheel. And LeBaron is equipped with a sophisticated electronic fuel system that's computer-directed.

And to further assure quality, the LeBaron Quality Assurance Program of 200 inspections is the most demanding ever for a Chrysler.

CHRYSLER QUALITY

In LeBaron you will find your new car. In your new car you will find the genius of Chrysler engineering. The series includes the ultimate luxury, LeBaron convertible† and the functional luxury of the new Town & Country.

Chrysler LeBaron coupe base sticker price $8,143.*

40 EST. HWY. 26 EPA EST. MPG**

Today Chrysler engineering is setting new standards for the auto industry. In Computer Aided Design (CAD) and Computer Aided Testing (CAT) Chrysler is so advanced that two auto companies and Boeing bought Chrysler programs. In Computer Aided Manufacturing (CAM) our automatic welders help build quieter cars with better fit and appearance. And by predicting parts endurance through plastic simulation, we build longer life into our new Chryslers.

The Chrysler Cordoba. Engineering excellence in a personal luxury car.

Here is the sophisticated design and road manners a fine car should possess. Cordoba's riding comfort and privacy from road noise are simply astounding, the result of a refined suspension system created with the aid of computer design.

Power steering, power front disc brakes and automatic transmission are all standard, all matched to a smooth and supple six-cylinder engine that was honed to excellence for drivers who love to drive.

Come. Come to Cordoba. Come for elegance. Come for excellence. Come for Chrysler engineering.

Chrysler Cordoba base sticker price $9,197.*

22 EST. HWY. 18 EPA EST. MPG**

The Chrysler New Yorker. The best luxury car value in America.

The sleek, new contemporary-sized New Yorker is crafted in the great Chrysler tradition of personal attention to engineering quality. And it is fitted with so many standard luxuries that it is the best-equipped luxury car value in its class. No other luxury car matches its combination of astonishing equipment and favorable price.

New Yorker standard luxuries include • 60/40 Cloth & Vinyl Seats with Passenger Recliner • Air Conditioning • Automatic Transmission • Electronic Ignition System • Dual Horns • Power Front Disc Brakes • Power Windows • Power Steering • Premium Wheel Covers • WSW Steel Belted Radials • AM Radio • Electronic Digital Clock • Special Sound Insulation • Galvanized Steel for Corrosion Protection • Front Torsion Bar Suspension System • Halogen Headlamps • Rear Window Defroster • Premium Plush Pile Carpeting • Dual Remote Mirrors • Tinted Glass • Trunk Dress Up • Bumper Guards • Warning & Interior Light Packages • And More.

The plush new New Yorker is the flagship of Chrysler luxury, Chrysler value, Chrysler engineering. It drives on pride.

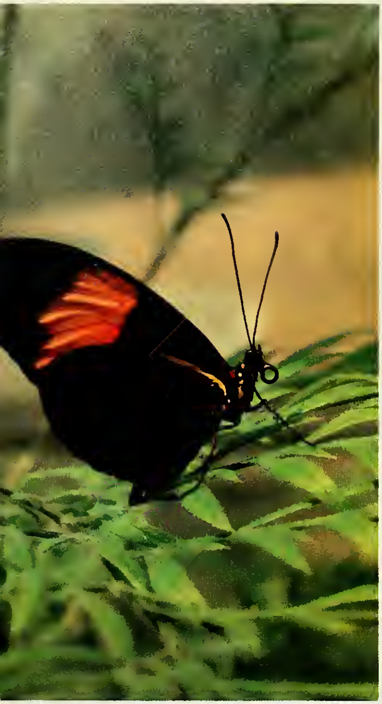
22 EST. HWY. 18 EPA EST. MPG**

Chrysler

THE NEW CHRYSLER CORPORATION

*Sticker price excluding taxes, title and destination charges. Cordoba wide WSW tires shown $116 extra. **Use EPA est. MPG for comparison. Actual mileage may vary due to speed, trip length and weather. Highway and Calif. mileage lower. LeBaron ests. for coupe and sedan only. †Convertible available late spring.

John R. G. Turner



A striking example of Müllerian mimicry is displayed by the color patterns of heliconiid butterflies. Both Heliconius melpomene, *above, and* H. erato, *opposite page, are unpalatable to avian predators, and their similar color patterns serve as signals of their distastefulness. The convergence of colors in these species helps to condition birds to avoid both species; different color patterns would result in birds attacking more individuals before they learned that these butterflies were unsuitable prey.*

Airborne Models and Flying Mimics

Certain colorful butterflies taste terrible.
Others taste good. Hungry birds
have trouble telling which
is which, so they avoid both

by Alexander W. Hiam

In 1862, Henry W. Bates, in an article published in *The Transactions of the Linnean Society of London*, reported his findings during eleven years of study and exploration in the Amazon Basin of Brazil. With the article appeared two colored plates depicting certain butterflies of the genus *Leptalis* that looked very different from their closest relatives and strikingly similar to several widespread heliconian butterflies. *Leptalis* butterflies, including the familiar cabbage butterfly, are in the family Pieridae, and do not usually look at all like the long-winged, brightly colored heliconiids of the American tropics.

Bates observed that although heliconiids are fragile, conspicuously colored, and slow fliers, they are rarely eaten by birds, the major vertebrate predators of most butterflies. He concluded that they must be unpalatable to birds and theorized that edible butterflies that resemble inedible or distasteful species might receive protection from predators. His theory explains why edible species mimic the bright warning colors, the aposematic coloration, by which an inedible species makes itself conspicuous and easy to remember.

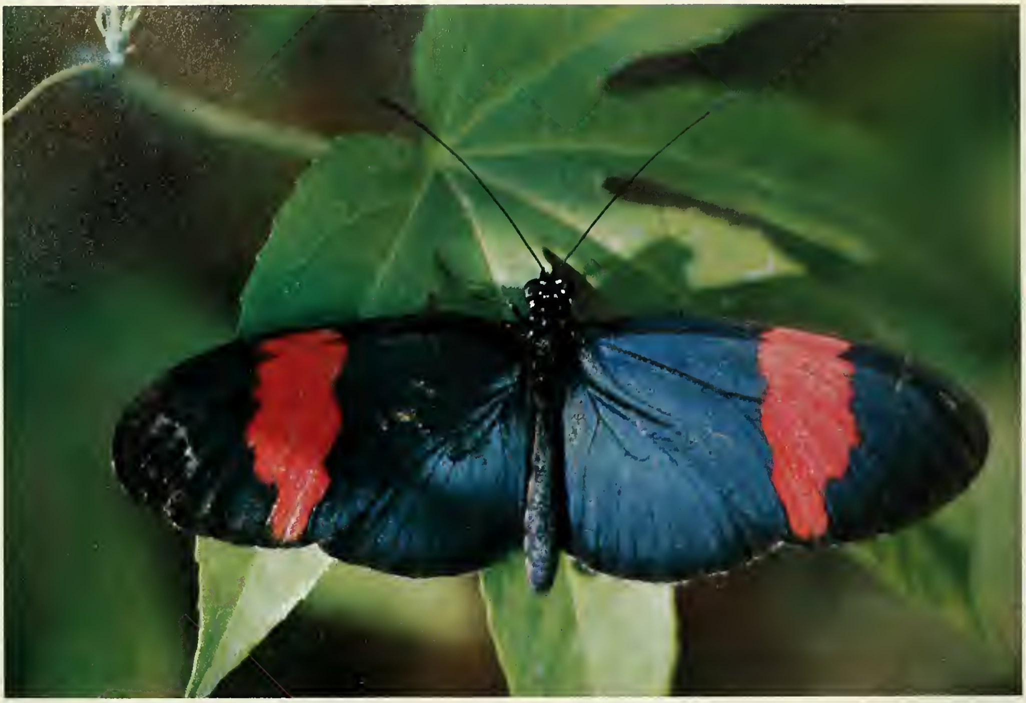
This explanation was widely accepted, and the imitation of an inedible species by an edible one—now called Batesian mimicry—has since been reported in a wide range of animals. For example, many harmless flies mimic stinging bees and wasps, some roaches mimic unpalatable ladybird beetles, and in Borneo many squirrels mimic tree shrews, whose flesh is distasteful to potential predators. Edible mimics of unpalatable species are only better off, however, if predators that have learned to avoid an inedible species mistake them for such a species. If the proportion of Batesian mimics to inedible models is too large, predators will not learn to avoid the shared pattern.

While Bates was the first to introduce the heliconiids to the world of evolutionary theory, many other biologists have since found inspiration in this interesting group of tropical forest butterflies. Bates's paper appeared just a few years after Charles Darwin and Alfred Russel Wallace (who studied butterflies with Bates in Brazil) presented their theories of natural selection, and in the controversy that followed their presentations, Bates's observations of mimicry provided an important test case for natural selection theory. Fritz Müller also observed heliconiids in Brazil, and his paper on mimicry, published in 1878, solved a mystery Bates had been unable to explain: why do many inedible species look alike? Müller proposed that mimicry between equally unpalatable species was the result of convergence on a common warning signal directed at a shared predator. If all unpalatable species in an area use the same pattern to advertise their distastefulness, predators will quickly learn to avoid them all, and the burden of training predators will be spread more thinly.

Both mimicry between inedible species, now called Müllerian mimicry, and Batesian mimicry are widespread in the heliconiids, and the result is remarkably

John R. G. Turner

L. E. Gilbert

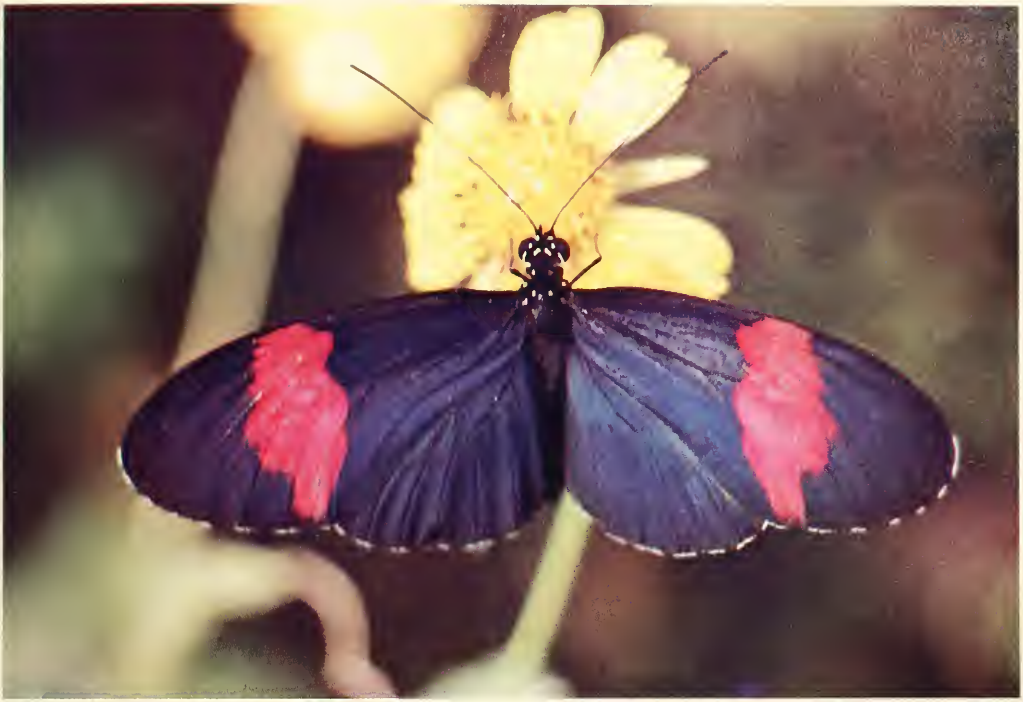


confusing. Many species look almost identical, and because heliconian butterflies are often the models for mimics of other families, they resemble a number of unrelated species as well. Some heliconiid species have many different forms, each with a wing pattern appropriate to local forms of other species with which it is associated. For example, *Heliconius erato* and *H. melpomene* are Müllerian mimics; each has about thirty distinct geographical races with different wing patterns. Wherever the pair occur they take the same form. At any one locality they look almost identical, despite the great variation found throughout their ranges.

Like most great ideas, the theories of Bates and Müller raised more questions than they answered, and many subsequent researchers have returned to the heliconiids. One central problem that was only recently resolved concerns the unpalatability of butterflies; for many years biologists had assumed that Müllerian mimics are distasteful or poisonous, but no direct proof of this had been obtained. In one experiment that provided such proof, seven species of heliconiids were offered to captive silver-beaked tanagers in Trinidad to see if birds really do avoid heliconiids. Four of the butterflies, including *H. erato* and *H. melpomene*, were consistently rejected by the birds, but three others were occasionally eaten. This suggests that the latter are Batesian, rather than Müllerian, mimics. (Apparently not all heliconiids are unpalatable.) The experiment also suggested that wild birds do not eat many heliconiids when given the opportunity. The birds in this experiment may have had some experience recognizing inedible species, but another experiment using inexperienced young blue jays was conducted in Trinidad by Lincoln Brower of Amherst College. He offered brightly colored monarch butterflies (*Danaus plexippus*) to cage-reared birds and found that they were readily accepted at first. After eating the monarchs, however, the blue jays became ill, threw up, and soon learned to avoid similar-looking butterflies. Monarch caterpillars feed on various species of milkweeds, many of which contain poisonous cardiac glycosides. The plants produce these chemicals to protect themselves from herbivores, but monarchs have developed the ability to tolerate and store the chemicals, making them poisonous as well. Although monarchs are not heliconiids, this experiment is the best evi-

The two heliconiid species H. melpomene, *above, and* H. erato, *right, each have about thirty distinct geographical races. In each locale where they occur together, the two species have evolved virtually identical color patterns, thereby mimicking each other.*

L. E. Gilbert



dence we have of how birds learn to avoid a distasteful butterfly species.

Studies of the chemistry of plants have revealed that many species use such chemical defenses, and many butterfly larvae feed on toxic plants. The ability to tolerate high levels of toxins is at the core of butterfly mimicry, for without the distastefulness this confers, no butterflies would have evolved aposematic coloration in the first place. Interestingly, unpalatability is most common in species that feed on nectar as adults, such as the heliconiids. These species are most vulnerable to predation by birds because their search for nectar brings them into sunny open areas. The heliconiid caterpillars feed on various species of passionflower vines, many of which contain toxins; therefore many heliconiids are also toxic to varying degrees.

Brower's experiments demonstrate that birds do learn to avoid inedible butterflies after a bad experience with them, but they pose a problem for natural selection theory. Previously the assumption was that a bird discovered a butterfly's unpalatability by tasting it, perhaps by eating a small piece of its wing, without usually killing it. In the blue jay experiment, however, the young birds had to eat at least one butterfly to learn it was poisonous, so how did these butterflies benefit from their distastefulness? Put another way, how would the first monarchs or heliconiids that developed an ability to make birds sick pass the trait on if they were eaten anyway? A way out of this dilemma is provided by the kin-selection theory, which was developed in the early 1960s. Kin-selection theory predicts that individuals will be altruistic toward each other to the extent that they share the same genes. If members of the same brood of poisonous butterflies live in the same local area, then the predator that eats one and becomes sick will avoid eating the unpalatable butterfly's relatives, and the trait will be passed on through them.

This theory lends itself to testable predictions. The more closely related the inedible butterflies in an area are, the more benefit there will be through kin selection, and therefore such life history traits as low dispersal rate, high inbreeding in local populations, and gregarious roosting might be expected in inedible butterflies. The opposite should be true of those species that rely on camouflage, or cryptic patterns, to hide from predators or that mimic distasteful species but are themselves edible. In such species, high density increases the likelihood that a predator will develop a search image for the species, and makes it more worthwhile for a predator to search for them. Research has found that, as predicted, edible and distasteful species do have many contrasting life history traits.

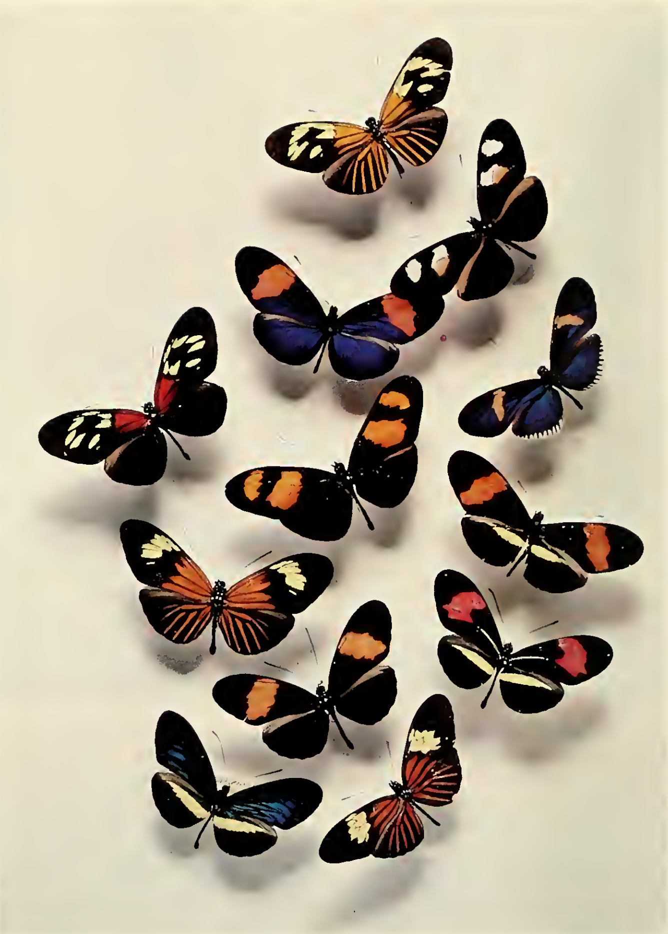
For example, when the life histories of the Trinidad butterflies that were tested for unpalatability are compared, those species rejected most frequently by the birds, and so presumably most poisonous, conform well to the expected pattern. They form site-specific roosting aggregations in the wild, living in small home ranges and returning to the same roost day after day. Members of a brood disperse little in their lifetime, and there is probably a high degree of inbreeding in local populations. Those species that were eaten most frequently by the silver-beaked tanagers have very different life histories. They do not form gregarious roosting aggregations, and they have higher dispersal rates. In addition, one of the species, *Heliconius doris*, often occurs simultaneously in two or three forms. In Costa Rica, for example, it has forms with light blue, yellow, or red hind wings. The occurrence of more than one form at the same location is not expected in unpalatable species, because those individuals that deviate from the most common pattern lose the protection that it gives. Apparently *H. doris* is an edible Batesian mimic, and its forms mimic several inedible swallowtails and heliconiids that occur in different parts of its range in Costa Rica.

Müllerian mimicry is presumed to be most effective where there is only one wing pattern at any one location, as this makes it easier for predators to learn which butterflies to avoid. But the visitor to a tropical rain forest can often observe a dramatic variety of brightly colored, slow-flying butterflies at one location. This is because there are often four or five rings, or complexes, of mimics, each composed of many species, at any locality. In a recent study, Christine Papageorgis of Princeton University found that at three rain forest sites in Peru, each locality had five similar mimicry rings, each ring corresponding to a different height in the forest and containing at least one inedible species. All butterflies that fly at the same level share a wing pattern, but differ from butterflies of other levels. Nearest the ground is the transparent complex, composed of the delicate, clear-winged ithomiid butterflies with distinctive black wing venation. Above this complex is the tiger ring, made up of danaids, ithomiids, and a few heliconiids with yellow or orange, dark-striped wings, followed by the red complex, whose major model species are *H. erato* and *H. melpomene*, with red patches on their dark wings. The top two complexes are composed entirely of heliconiids: the blue ring, characterized by butterflies with blue on the hind wings and yellow on the forewings, lies below the orange ring of the upper canopy, characterized by orange species with black margins on their forewings.

To explain why different wing patterns are typical at different heights, we must reexamine the assumption that distasteful species will always advertise their presence with as conspicuous patterns as possible. Papageorgis found that some edible, nonmimetic butterflies also showed similar variation at different heights in the rain forest, and that the members of mimicry rings were not as distinct from nonmimetic, cryptic species as they should be if their patterns were designed to make them stand out. This led her to observe that as the interplay of light and shadow varies at different levels of the forest, different colors and patterns become cryptic at each level. The patterns of each mimicry complex are fairly inconspicuous in the viewing conditions characteristic of the levels on which they are found, and flying heliconiids blend into the background by appropriate disruptive coloration. Rather than having conspicuous patterns, the heliconian butterflies may have developed patterns that are not immediately conspicuous to predators from a distance. The distinctive aspect of their patterns is that they are striking and memorable at close range. Papageorgis's thesis is that selection has emphasized patterns that, once encountered, are easily remembered by predators, but not patterns that attract excessive attention.

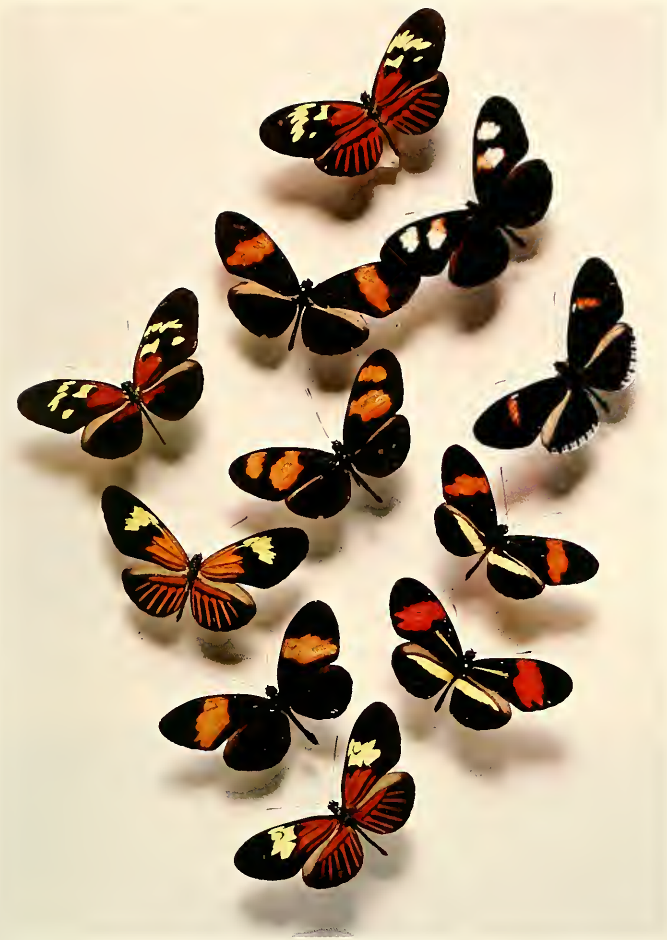
This theory has not met with complete acceptance. It is difficult to imagine that selection could be balancing conspicuousness with inconspicuousness to produce a pattern that is cryptic until

AMNH



These butterflies represent eleven races of H. erato, *above, and* H. melpomene, *right, that are distributed throughout South America. Each race evolved in response to local conditions, then further evolved into identical-appearing mimetic forms. (*H. erato *has one geographical race that does not have an* H. melpomene *counterpart.)*

AMNH



detected, but when seen is conspicuous and memorable. Yet this is just what Papageorgis's findings indicate is true of heliconiids and other members of tropical forest mimicry rings. While such a hypothesis is consistent with the fact that many butterflies do not survive attacks by predators, more evidence will be required before it is completely accepted. This hypothesis could lead to some interesting questions for evolutionary theory. For example, could the balance between cryptic and aposematic aspects of heliconiid wing patterns reflect a balance between individual selection for self-preservation and kin selection for altruism? Or could there be some as yet undetected predator that is resistant to the toxins of the inedible heliconiids?

Another subject of debate over the years concerns how convergent patterns evolve in mimicry. One school of thought has argued that because there is no advantage to an edible butterfly that looks just a little like an inedible one, the actual evolution of mimicry is impossible except where butterflies already look somewhat similar. Unless evolution is able to work by leaps and bounds, it might be impossible for the members of different complexes to converge on one wing pattern, given the major differences that exist between patterns of the different complexes.

In an experiment conducted by Lincoln Brower, Jane Brower, and John Alcock, silver-beaked tanagers and fork-tailed flycatchers were offered *H. erato* and a range of butterflies resembling this inedible species in varying degrees. All of the latter were edible and none were good mimics of the black and red *H. erato*. Two of the butterflies, *Biblis hyperia* and *Anartia amelthea*, are black with red markings, as is *H. erato*, but their wing patterns and shape are clearly different. The other species did not have any red or black on their wings and served as controls. The birds avoided the two imperfect mimics to a significant degree and rejected almost all the *H. erato* that were offered but ate all the controls. This demonstrates that some protection can be derived from even a slight resemblance to a distasteful model.

This experiment also suggests that the mimicry complexes Papageorgis observed in Peru could have become more similar through gradual evolution had selection favored greater uniformity of pattern. Therefore, her theory that patterns are adapted both for predator recognition and for their cryptic qualities is the only available explanation for the phenomenon of multiple complexes at one site. But the matter is still not settled, and other factors may prove important. For example, recent ornithological research has revealed that the insectivorous birds of tropical forests divide up their habitat vertically, much as the butterflies do, and most species feed almost entirely at a specific level. It could be the case that avian predators are different for each mimicry complex, and if butterflies of different strata do not share predators, then there would be no selective advantage to converging on the same pattern. This might explain why patterns have remained diversified and have been able to respond to the specific visual environment of each level.

These studies help explain how Müllerian and Batesian mimicry have affected the appearance and behavior of heliconiid butterflies. But mimicry, based on the convergence of wing patterns, has also played an important role in speciation. Heliconiids underwent a dramatic adaptive radiation; in other words, a great diversity of local variations of a single ancestral population resulted in the great number of species and races found in the group today. This diversification, encouraged by a combination of changes in the distribution of tropical habitats in the Pleistocene, was described by John R.G. Turner, who has studied heliconiid evolution for many years, in an article for *Natural History* in February of 1975. However, the basic adaptations to distastefulness and Müllerian mimicry, such as small, inbred local populations and rapid convergence on the central model species in an area, provided the basic building blocks necessary for evolutionary diversification.

Race and species differences are most obvious in the beautiful and varied wing patterns that have evolved, and the great number of distinctively patterned species and races has made it possible to study the genetics underlying this adaptive radiation by examining the results of cross-breeding between members of different races. This Mendelian approach has led to a detailed understanding of the genetic basis of wing-pattern variation. Work with *H. erato* and *H. melpomene* has indicated that the members of the series of pairs of genes that control wing pattern in any one individual will all be alike. This condition, called homozygosity, means that all the egg or sperm produced by the individual will be genetically alike with respect to wing pattern, and hence that butterflies of the same race will always breed true for their particular wing-pattern traits.

The classical concept of evolution assumes that races will evolve by changes from homozygosity for one set of alleles (the individual genes in a pair) to homozygosity for another, and genetic studies of heliconiids suggest that their evolution has proceeded as classical evolutionary theory would predict. If the races were heterozygous with respect to wing pattern, a condition in which the alleles are not identical matches, then members of the same race would not breed true for wing pattern. Such diversity is acceptable in many cases (as in the case of eye color in humans), but in butterflies, where mimicry of a common wing pattern confers protection, heterozygosity would be disastrous. Homozygosity for wing pattern, and the resultant genetic discontinuity between races, is therefore consistent with what is known of the functions of wing pattern in these butterflies and suggests that racial differences in wing pattern evolved quite quickly as the result of strong selection imposed by predation.

In the last decade a new concept of evolution has emerged from studies in molecular genetics, which in some ways contradicts this classical model of evolution. Researchers have learned that many amino acid substitutions occur in the genome and that the frequencies with which different amino acids are found in close alignment may be the result of a random process. Many of the mutations that occur in the genome seem to have no practical effect, to be selectively neutral, and so occur essentially at random. Of course, other mutations may be harmful and hence eliminated by selection. These findings have led to the development of a neutral theory of evolution that postulates that these accidental changes with no selective value when they occur may be as important in the evolution of new forms as are the changes in the frequency of genes caused by natural selection for specific traits in the classical manner.

Because the heliconiids present such a dramatic example of adaptive radiation, and because the genetic basis and functions of their wing patterns are understood, they provide a perfect test case for the neutral theory. In 1979, several researchers applied new techniques of protein chemistry to this group, using a method that measures allozyme variation between races as an indication of the overall genetic variation between them. The broader picture of genetic variation provided by this technique is in sharp contrast with the situation involving those genes associated only with wing pattern. Races of *H. erato* and *H. melpomene* have a low level of allozyme differences between them, with heterozygosity and no genetic discontinuity between them. Investigators found that the amount of differ-

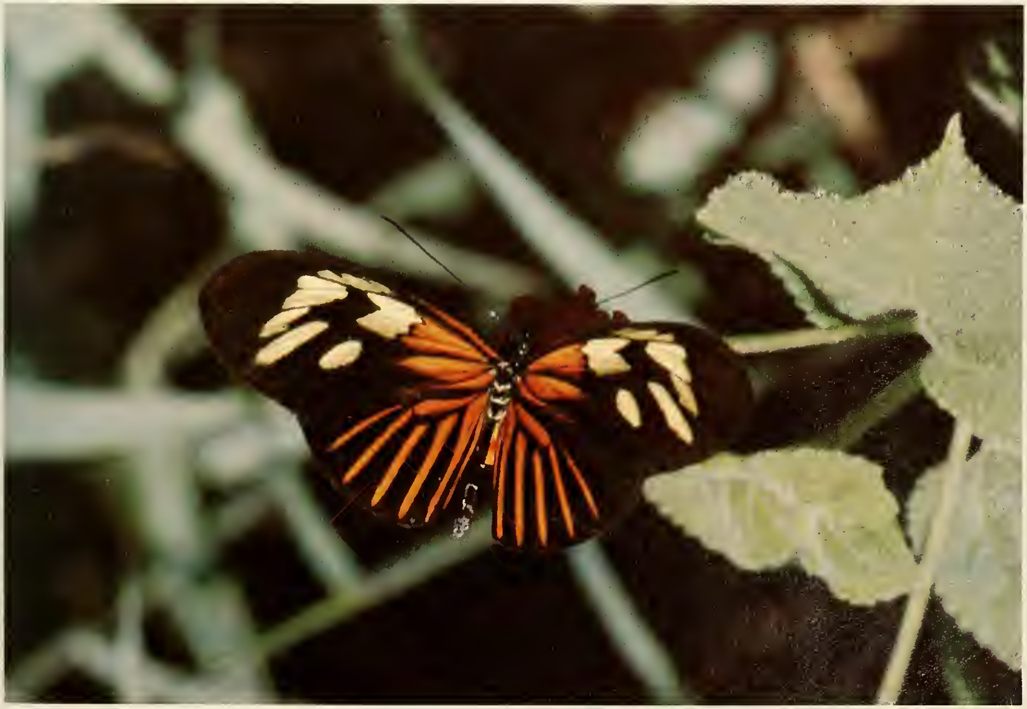
John R.G. Turner

ence between races at any one locus is related to the extent of heterozygosity in the species at that locus, suggesting that greater divergence resulted from a greater number of random mutations. These findings are consistent with the neutral theory, and suggest that genetic variation between the races is the result of gradual change caused by random substitutions, rather than rapid change caused by strong selection in favor of specific mutations. These results contradict those obtained through crossing races and observing wing patterns. The likelihood is that both neutral and classical evolution are occurring in the heliconian butterflies, and that the strong selection for discrete wing patterns in different races does not affect any genes that are not directly associated with wing pattern. This study demonstrates that different parts of the genome can evolve in different ways at the same time.

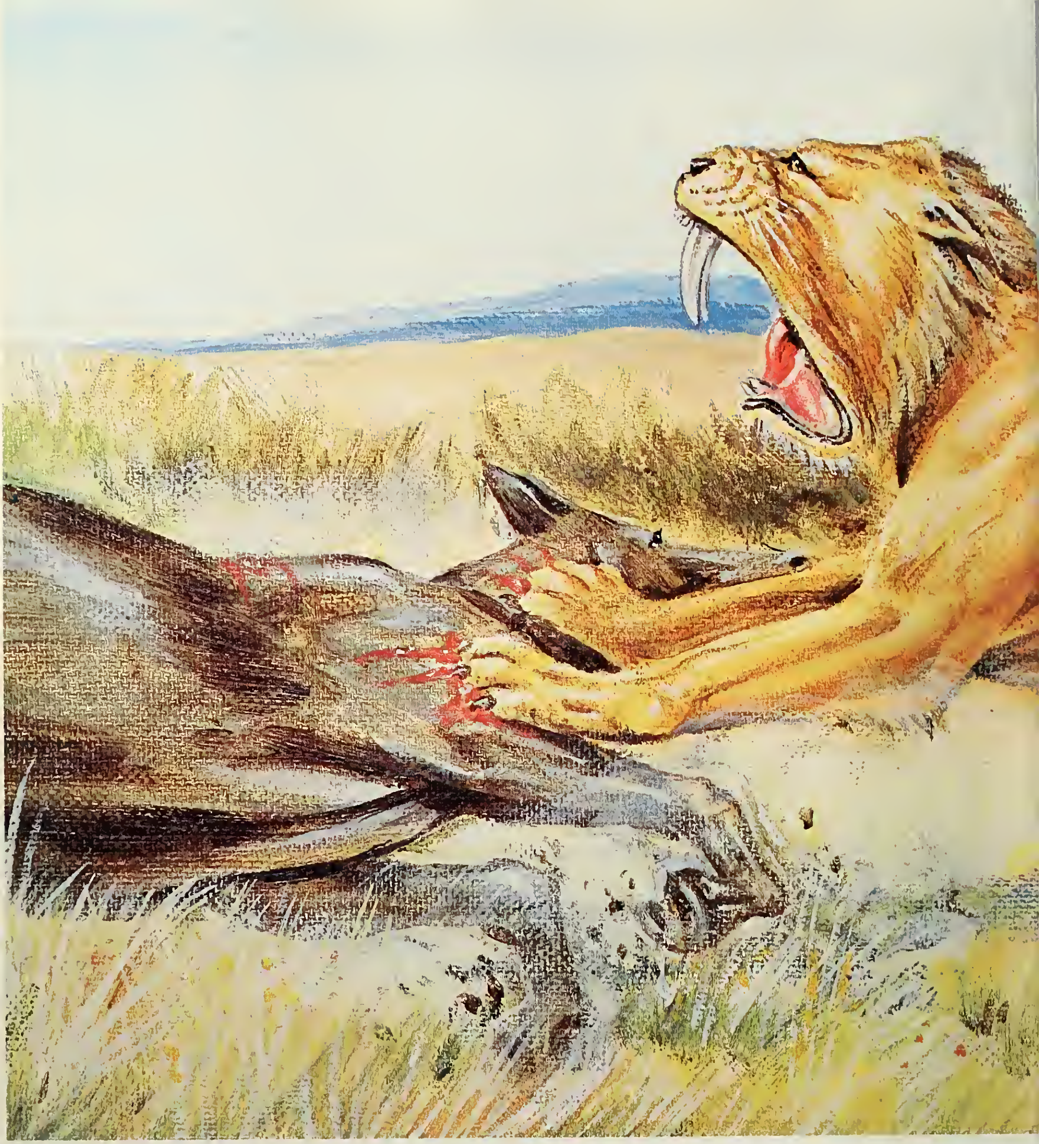
The theory of neutral evolution is still a subject of lively debate, as was the theory of natural selection when Bates and Müller first revealed heliconiid mimicry. By providing an example of how neutral and classical evolution can interact, the heliconian butterflies once again point the way to a better understanding of the process of evolution. This group of insects has been of remarkable importance in the development of theories of ecology and evolution, from natural selection through the development of kin-selection theory and now the theory of neutral evolution.

Perhaps the first quality that brought the heliconian butterflies into the spotlight is their beauty; they have been attracting collectors since before the time of Bates and, as a result, many individuals of most species have been collected and are available to researchers at museums. Moreover, the aposematic coloration and slow flight of these butterflies make them easy to study. The remarkable variation in wing patterns, both within and between species, coupled with the striking similarity between many species, makes the group a constant source of interesting questions. Their development of distastefulness as a predator defense led to the evolution of a wide range of associated traits and made them a showcase of evolution and ecology. Indeed, some species have by now received so much attention from scientists and collectors that we should probably start looking for adaptations to human predation as well as bird predation. ☐

The conspicuous coloration of H. melpomene, *left, and* H. erato, *below, is a form of advertising, warning potential predators that these butterflies are distasteful. A palatable species of butterfly that evolved a similar color pattern would receive some protection from its false advertising. Such a situation would be an example of Batesian mimicry.*



John R.G. Turner



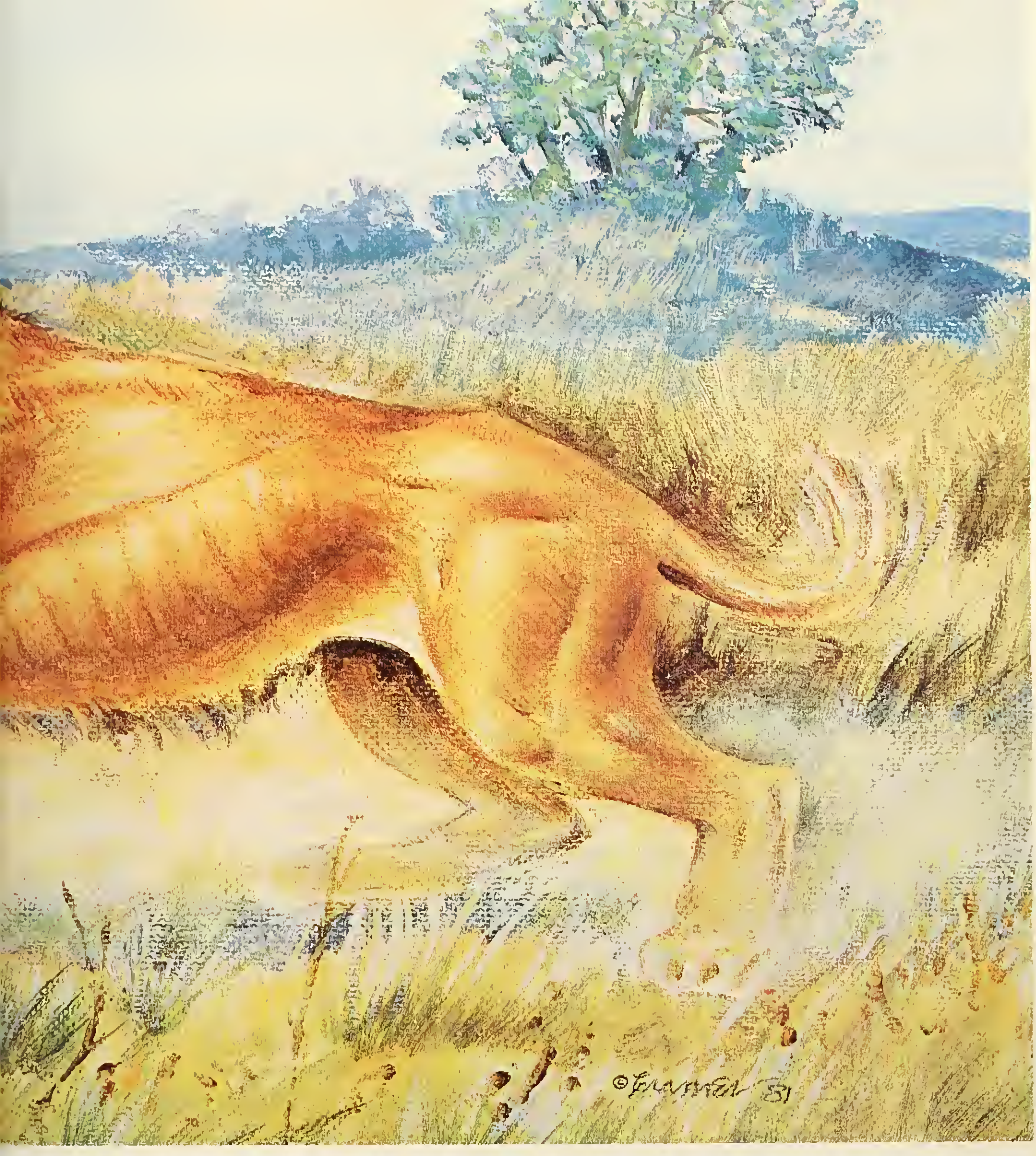
The Late, Great Sabertooths

Paleontologists wonder how these prehistoric animals killed their prey and why they evolved more than once

by Leonard Radinsky and Sharon Emerson

Illustrations by Douglas L. Cramer

About twelve million years ago, a new kind of large felid appeared in the forests and savannas of North America and Eurasia. About the size and build of a leopard, this member of the Felidae, or cat family, was remarkable in having very long, slender, bladelike upper canine teeth, from which it got its name—sabertooth. This early felid sabertooth had upper canines about one and a half times as long, but less than half as wide, as the sturdy conical canines of its non-saber-toothed ancestors, primitive felids



whose canines were like those of such modern cats as lions, tigers, leopards, cheetahs, and jaguars. The ancient felid sabertooth was a successful killer and gave rise to several species of sabertoothed cats, which coexisted with the short-canined ancestors of modern felids for millions of years. It was only about 10,000 years ago that the last of the sabertoothed felids finally became extinct.

Paleontologists and biologists have long been intrigued by sabertooths. Some of the later forms, such as the genus *Smilodon*, found in the Rancho La Brea tar pits in Los Angeles, were lion-sized animals, with very powerful forelimbs and curved canine blades six inches long but only three-quarters of an inch wide at the base. How could these creatures have opened their mouths wide enough to clear the canines for use? How could they have attacked prey without breaking their long slender teeth? And finally, why, after being around for so many millions of years, did they become extinct?

In this artist's reconstruction, Barbourofelis, *a nimravid sabertooth that lived about seven million years ago, is about to slash the throat of a three-toed horse with its long, bladelike upper canines. The sabertooth's powerful forelimbs and strong claws hold the struggling prey in position for the kill.*

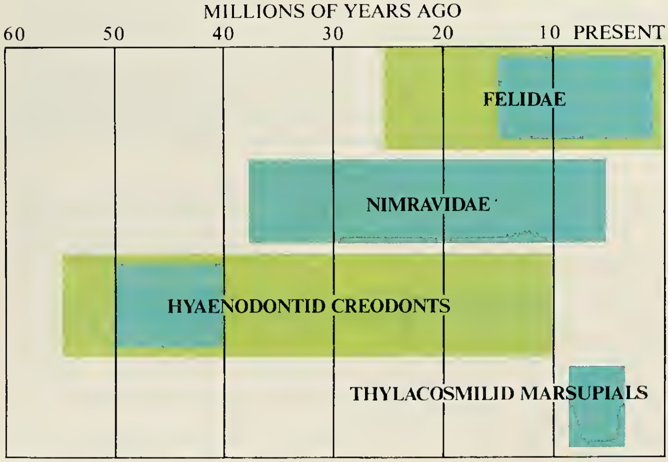
That the canines of saber-toothed felids did indeed serve an important function is indicated by what may be the most striking aspect of the sabertooths' evolutionary history, namely, that the morphological adaptation of saberlike canines evolved, not once, but four distinct times. More precisely, when the first felid sabertooths evolved, a much older line of sabertooths, now known as the family Nimravidae, already existed in North America and Europe. The nimravids were powerfully built carnivores, mostly lynx to jaguar sized, with retractile claws like those of felids. They appeared 37 million years ago, and the last of them died about 5 million years ago, well after the first appearance of the felid sabertooths. Moreover, sabertooth characteristics evolved among an ancient group of carnivores called creodonts (in members of the family Hyaenodontidae, which lived between 50 and 40 million years ago) and also among South American marsupial carnivores (in members of the family Thylacosmilidae, distant relatives of opossums that lived between 8 and 4 million years ago). Sabertooths thus evolved independently in four different groups of carnivores: felids, nimravids, creodonts, and marsupials. The four groups had in common long canine teeth and differed in that respect from their ancestors, but they also differed from one another in anatomical details that indicate their distinct origins. Because of their similarities, the four groups are a good example of convergent, or parallel, evolution (as the independent development of similar specializations is called) and are thus of particular interest to biologists who study evolutionary phenomena.

In order to tackle the tantalizing question of why sabertooths evolved four different times, it is necessary to determine the function of their particular morphology. In other words, how did these carnivores use their saberlike canines? Ideally, a paleontologist approaches this kind of question by looking for modern animals with similar structural features, observing how the structures are used in the modern species, and then extrapolating back to the extinct species to infer its way of life. There are, unfortunately, no living sabertooth carnivores, so unrestrained by modern examples, paleontologists have speculated freely about the sabertooths' way of life. In particular, some paleontologists have suggested that sabertooths must have been scavengers rather than active predators, based on the assumption that their jaws were too weak and their canines too long for killing live prey. Others have viewed sabertooths as blood lappers whose jaws were incapable of opening wide enough to take in chunks of meat; as killers that stabbed or slashed with jaws closed (again based on the assumption that the jaws could not open wide enough to clear the upper canines); or as predators of very large, thick-skinned prey, with the elongate canines having evolved for stabbing through thick hides. Finally, by extrapolating from the attack behavior of modern felids, some paleontologists have argued that sabertooths killed large prey by stabbing into the back of the head or the nape of the neck.

The problem with all these suggestions is that they ignore or incorrectly interpret known aspects of sabertooth anatomy. In order to shed some light on the many questions concerning sabertooth morphology, we have recently conducted a functional study of sabertooth skulls. We were particularly interested in seeing how the various kinds of sabertooths differed from their respective short-canined relatives, in drawing inferences about the function of the features shared by the different families of sabertooths, and in gaining insights into these carnivores' mode of attack and way of life. Our perspective was inspired by the work of Bjorn Kurtén, a Finnish paleontologist. Thirty years ago, Kurtén pointed out some of the features of the skull that allowed sabertooths to open their mouths wide and noted that despite the great length of the canines, sabertooths were not capable of stabbing deeply, but most likely killed their prey with shallow slashes. We began our own study by looking at modern felid skulls as an engineer might, and identified a series of measurements that reflected significant aspects of skull form.

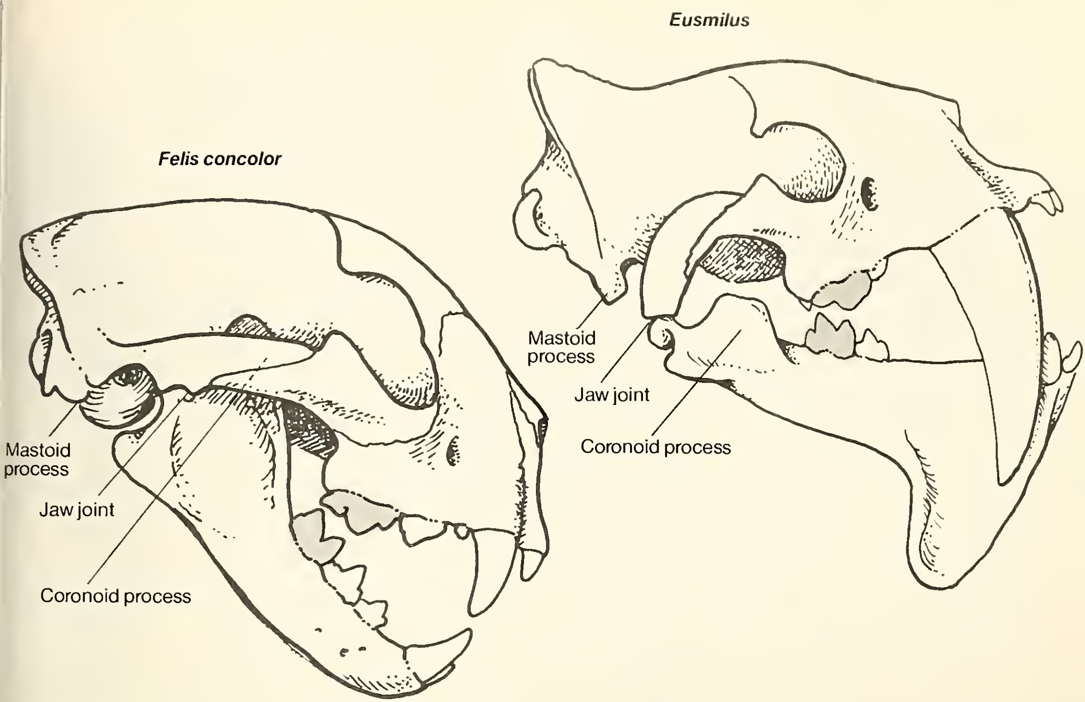
Animal jaws can be viewed as sets of levers, analogous to such familiar levers as nutcrackers and seesaws. By measuring the length of the lever arms and estimating the size of jaw muscles, we could compare the construction and mechanical efficiency of the sabertooths' feeding apparatus with that of their non-saber-toothed relatives. We also measured brain sizes and such sense-organ housings as eye sockets and middle ear cavities, because differences in those structures can reflect behavioral or ecological specializations. And we compared scale drawings of nonsabertooth and sabertooth skulls to search for differences not captured by the measurements.

To understand the mechanics of sabertooth jaws, we needed first to know the gapes of modern felids, that is, how wide they can open their mouths. That is not as easy to find out as it may seem, but we were fortunate in having access to Hoover, a black jaguar at the Brookfield Zoo in Chicago that likes to play with bowling balls. We photographed



AMNH

Sabertooth characteristics (blue) evolved in four distinct groups of carnivores: in the Felidae, or modern cat family; in the closely related but now extinct family Nimravidae; in the Hyaenodontidae, a family of ancient carnivores known as creodonts; and in the Thylacosmilidae, an extinct family of South American marsupials.

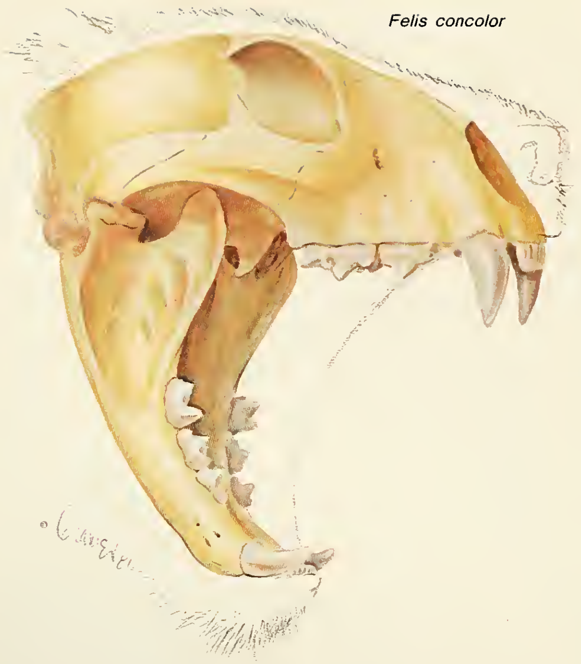


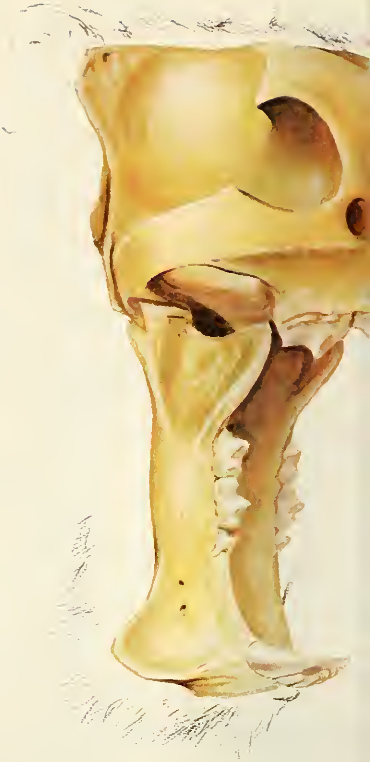
With the evolution of saberlike upper canines came correlated morphological changes in the skull, as is shown in this comparison of a modern mountain lion, left, and a highly specialized nimravid sabertooth, right. In the nimravid, the mastoid process, where powerful head depressor muscles originate, is enlarged, providing for better leverage that facilitates the sabertooth's slashing attack. The nimravid's lowered jaw joint and shortened coronoid process, where the main jaw-closing muscle attaches, allow for longer muscle fibers, making possible the wider gape needed to clear the long canines for use. The gape is further widened through the upward rotation of the face relative to the braincase, and leverage needed to maintain a powerful shearing bite has been secured by the positioning of the carnassial teeth (gray shading) relatively closer to the jaw joint.

Hoover trying, unsuccessfully, to get his jaws around a bowling ball of known diameter; once we knew his head size, we calculated his maximum jaw gape from the photographs. We also stretched open the jaws of anesthetized felids being treated in the zoo hospital and measured their maximum gapes. These methods suggested a maximum jaw opening of about 65 to 70 degrees in modern felids, which agrees with estimates made by rotating the jaws on skulls. Beyond that amount of gape, the jaws disarticulate, or pop out of the joint. In sabertooths, jaws don't disarticulate until they are rotated open about 90 to 100 degrees.

A major limiting factor in gape size is the length of the jaw muscle fibers, which can only be stretched to about one and a half times their resting length. Our study of sabertooth skulls showed that in the evolution of sabertooths, skull shape changed in such a way that the distance between the area of origin and the area of insertion of the temporalis muscle (the main jaw-closing muscle) increased, resulting in a wider possible gape. In fact, our study showed that each of the four times sabertooths evolved, the shape of their skulls was modified in similar ways, which allowed not only for wider gape but also for increased power of downward head movements, while at the same time maintaining bite strength at the main chewing teeth. Not all sabertooths are exactly alike, however. Among the nimravid sabertooths, different species can be arranged in a series of increasing specialization that shows increasingly pronounced skull modifications with increasing canine elongation. Thus *Barbourofelis*, the last of the nimravids, is also one of the most highly specialized sabertooths. Also, some sabertooths have features that might be viewed as minor variations on the main theme of sabertooth skull form. For example, a number of sabertooths, including the marsupial *Thylacosmilus* and many nimravids, developed long flanges at the front of the lower jaws that extended downward about as far as the canines did when the jaws were closed. It has been suggested that those flanges evolved to protect the canines from breaking when they were not in use; but since not all sabertooths had such flanges, they were clearly not necessary for tooth protection.

What does all this tell us about the way sabertooths actually used their remarkable canines? To begin with, the

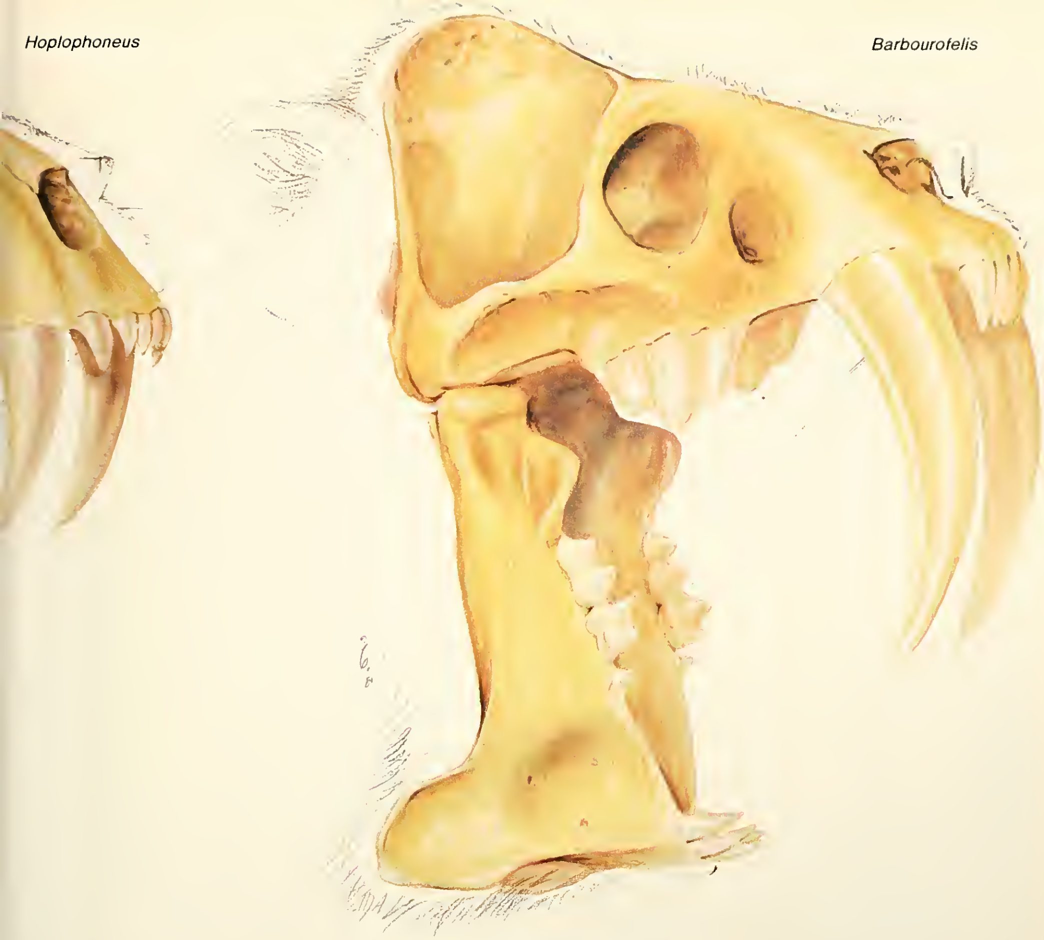




Changes in skull shape as upper canines lengthen can be seen by comparing the skull of a modern mountain lion, left, with that of a moderately specialized nimravid sabertooth, center, and a highly specialized nimravid, right.

assumption that sabertooths had jaws too weak, and canines too long, to kill prey and thus must have been scavengers or blood lappers is incorrect. Our study, as well as Kurtén's, demonstrates that skull modifications did, in fact, allow the sabertooths' jaws to open wide enough for the canines to be used against live prey and for meat to be ingested. At maximum gape, the distance from the tip of the upper canine to the tip of the lower canine is about the same in sabertooths as in modern felids. Further, sabertooth jaws were not significantly weaker than those of other carnivores, and although the jaw muscles were not oriented for generating biting strength with the front teeth, they were suitably arranged for powerful crushing and chewing with the back teeth. And no carnivore the size of even the smallest sabertooth could have lived mainly on a diet of blood. In addition, the idea that sabertooths stabbed deeply was refuted by Kurtén, who pointed out that, despite the widely gaping jaws, the curvature of sabertooth canines would have prevented the animals from plunging those canines deep into their prey. Finally, the suggestion that either the back of the skull or the back of the neck was the target of attack seems unlikely because of the shape of sabertooth canines. Since the canines are extremely long and very narrow from side to side, a bite in the suggested anatomical regions would have encountered bone that would surely have broken the canines.

How then did sabertooths kill their prey? Given what we know of sabertooth anatomy, the most likely hypothesis is that they killed with a long, shallow slash across the throat or lower neck. In those regions the canines would encounter no bone, and a single, well-placed slash would sever important blood vessels and result in rapid death. It might seem unlikely that a carnivore attack would be focused on a single, very limited region of the body, but modern felids usually kill with a precisely oriented bite. If the prey is small, they bite at the back of the head or neck, but if the prey is large they may fasten on the throat with their powerful jaws and throttle the victim. With a throat attack on large prey, the quarry must be pulled down and immobilized, and it is perhaps no coincidence that the earliest sabertoothed nimravids had retractile claws, which improve gripping and handling abilities, as well as elongate canines.



Having explored the function of sabertooth canines, let us turn now to the question of why sabertooths evolved four separate times. Convergent, or parallel, evolution usually occurs when it represents a best—or at least very good—solution to a common problem (see "A Darwinian Paradox," by Stephen Jay Gould, *Natural History*, January 1979). To what common problem did sabertooth morphology provide a solution in four different groups of carnivores? A possible answer comes from observations of prey capture in large living felids. These carnivores switch from the usual back of the head or neck attack to the throat attack when the prey is relatively large—equal to, or larger than, the felid itself. The throat throttle may take up to fifteen minutes to kill the prey; during this time, the prey may be thrown loose and the attacker is vulnerable to injury from its thrashing victim. Success rates for throttle attack by solitary cheetahs and lions range from about 10 percent to 40 percent, and it is advantageous to gain the greatest amount of potential food per attack—that is, to go for large prey as long as that does not lower the kill rate. Perhaps sabertooths represent another solution to the problem of killing relatively large prey. Instead of having powerful jaws that can hang on to large struggling prey for several minutes, as in the case of modern felids, they may have evolved saberlike canines for a quick slash that could kill almost instantly. Elongate canines require wide gapes, and given the common basic construction of mammal skulls, there are only a few ways to modify skull form in order to increase gape. Thus it is not surprising to see similar changes in skull shape in all sabertooths.

Did sabertooths kill very large, thick-skinned prey, as many paleontologists have suggested? The last of the sabertooths coexisted with some gigantic herbivores—including mastodons, mammoths, woolly rhinoceroses, and giant ground sloths—and these animals are often pictured as the likely prey of sabertooths. But large modern carnivores rarely, if ever, attack healthy adults of similarly large, contemporary herbivore species such as elephants, rhinos, and Cape buffalo. Sabertooths ranged in size from that of a modern lynx to that of a modern tiger, and it seems most likely that, like modern large carnivores, they preyed primarily on medium-sized herbivores such as antelope, deer, and zebras (which still represent relatively large prey compared to the size of the predators). The suggestion that sabertooths preyed on medium-sized, rather than very large, animals also agrees with the hypothesis that these carnivores used a slashing attack: since the depth of a slash varies with the degree of curvature of the body surface presented and the largest animals present the flattest surfaces, then the slashing attack would be least effective with the largest prey.

Finally, why did sabertooths become extinct? The common assumptions are that sabertooths had smaller brains than their short-canined contemporaries, that brain size is correlated with intelligence, and that sabertooths became extinct because they weren't smart enough to survive in competition with modern felids. But there is no evidence for any of these assumptions. Fossil endocranial casts show no consistent differences in the ratio of brain size to body size between sabertooths and their non-saber-toothed carnivore contemporaries. *Smilodon*, one of the last and best-known sabertooths, did have a relatively small brain for a felid, but another late sabertooth, *Dinobastis*, had a relatively large brain. In short, throughout their history, sabertooths appear to have matched their short-canined contemporaries in relative brain size. There is also no evidence that differences in relative brain size among various species of living carnivores are correlated with differences in intelligence. Performance in laboratory tests, such as maze running and visual discrimination problems, has been taken as evidence that bigger-brained animals are more intelligent, but such tests do not usually take into account the diverse sensory specializations and reactions of different animal species to laboratory conditions. Further, and most important, there is no evidence that success in laboratory tests is in any way related to evolutionary success in nature.

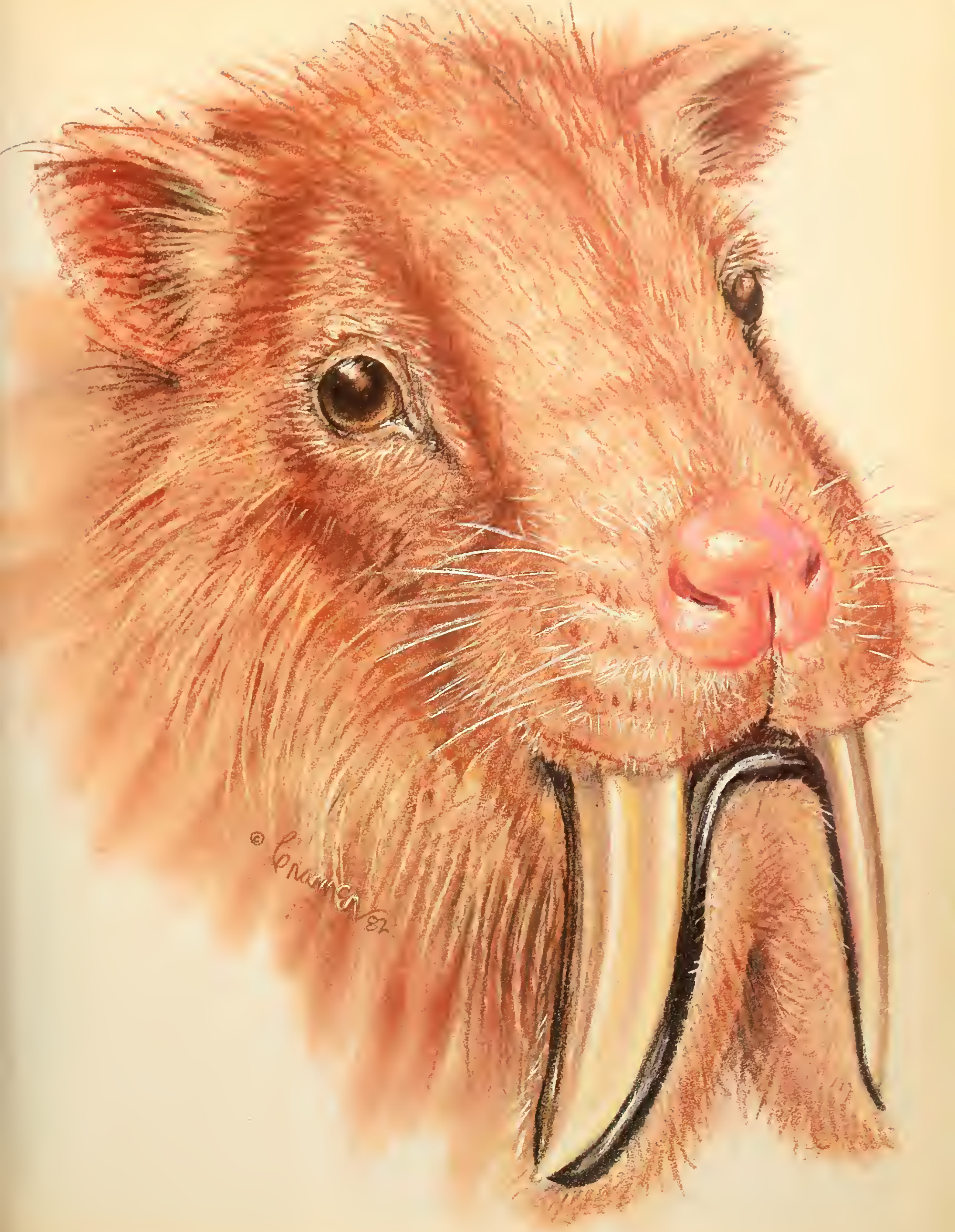
Sabertooths coexisted successfully with short-canined carnivores for many millions of years, and they were not the only mammals that became extinct at the end of the Pleistocene Ice Age. Many other species of large carnivores, as well as many kinds of large herbivores, also became extinct at that time. Suggestions for the cause of that great wave of large-mammal extinctions range from climatic changes to overkill by Paleolithic human hunters, and most probably, more than one factor was involved. Many different species of sabertooths appeared at various times and in various places during the approximately 50-million-year history of sabertooth carnivores, and the patterns of origination and extinction of sabertooth species do not seem different from those of their nonsabertooth relatives. Creodont sabertooths became extinct at a time when many other creodont carnivores became extinct, and the same holds true for the South American marsupial sabertooths. Various species of nimravid and felid sabertooths arose and became extinct at different times during the past 35 million years. The only unusual thing about the extinction of the last of the felid sabertooths at the end of the Pleistocene Ice Age is that, for the first time in a long time, there were no other sabertoothed species around. Because sabertooths coexisted with short-canined carnivores for so many millions of years, they were evidently not inferior types, and it may just be a matter of chance that we have no sabertooths with us today.

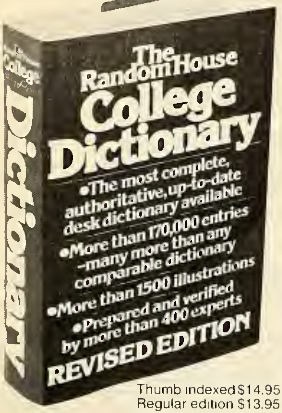
Some of the hypotheses about sabertooths presented here can be tested or at least investigated further. The conclusion that sabertooths had strong jaws and could chew like their non-sabertoothed relatives was inferred from the shape of their jaws. That hypothesis can be tested by examining the microscopic structure of the bone of sabertooth jaws, for bone is deposited and molded in response to how it is stressed and thus preserves a record of the stresses it is subjected to in a lifetime. The hypothesis that sabertooths killed with a shallow slash to the lower neck or throat cannot be tested directly. Such an attack, however, would require manipulating and controlling the prey to position it for the killing slash, and so one would expect to find relatively powerful forelimbs in sabertooths. The forelimb bones of a few species of sabertooths have been studied and do appear to be relatively robust compared with those of similar-sized modern felids, but no one has surveyed forelimb proportions in all, or even most, of the known species of sabertooths. Perhaps the few that have been looked at are not typical. A comparison of the limb bones of all sabertooths with those of a variety of non-saber-toothed carnivores would tell us whether sabertooths did indeed have relatively powerful forelimbs, a prerequisite for the mode of attack proposed above.

The hypothesis that the sabertooth mode of killing evolved to facilitate the taking of prey relatively large in comparison to the predator's body size can be investigated further by examining the size relationships of coexisting modern carnivore species to their prey. There is some evidence from modern carnivores that, at least for medium-sized to large species, prey size is correlated with predator size—that is, larger predators take larger prey. Thus carnivore species of different sizes may coexist without competing with each other for the same prey species. If that suggestion can be shown to hold for modern carnivore faunas, and a regular distribution of carnivore species by size is found in any given place, then one could examine the size relationships of the carnivore species found with sabertooths. If sabertooths did take relatively larger prey than did non-saber-toothed carnivores of the same body size, then one would not expect to find nonsabertooths that were slightly larger than sabertooths in a given fauna (otherwise they would both be competing for prey species of the same size). Of course, this line of analysis is based on the untested assumption that food is a limiting resource and that different species of similar-sized carnivores would compete for the same prey species, where the prey is in limited supply relative to the needs of the predators.

The South American marsupial sabertooth Thylacosmilus, *about the size of a leopard, was unique in that the roots of its upper canines extended back above the eyes. The animal was also endowed with a large flange that projected down from the lower jaw and may have protected the exposed canines. In this artist's rendering, the long flange is covered by an extension of the mouth lining, which is colored black.*

Sabertooths are only one of many hundreds of different kinds of unusual extinct organisms whose remains present us with fascinating puzzles. Insights gained from anatomical and ecological studies of living species, combined with careful analyses of the fossil specimens, help us unravel these puzzles and understand more about how extinct species lived. Inferring the ways of life of extinct organisms and charting the patterns of evolutionary change through time are contributions paleontologists can make toward understanding the history of life on Earth. □





THE Smart GIFT

The Random House College Dictionary
•The most complete, authoritative, up-to-date desk dictionary available
•More than 170,000 entries —many more than any comparable dictionary
•More than 1500 illustrations
•Prepared and verified by more than 400 experts
REVISED EDITION

Thumb indexed $14.95
Regular edition $13.95
Deluxe edition $15.95

Now at your bookstore RANDOM HOUSE
Publishers of *The Random House Dictionary of the English Language, Unabridged Edition*

Free--40 Pages of Peru

Faucett's Peru

Faucett's Peru is the ultimate guide to the land of the Andes Mountains, desert mysteries and the Amazon rain forest. All the facts, figures, photographs and details you'll need to plan your Peruvian adventure.

Faucett Peruvian Airlines
3095 N.W. 77th Avenue, Miami, Florida 33122
Or call 1-800-327-3368 and ask for Penny.
(In Florida, call 1-800-432-3239; Miami, 592-7536.) NS-4/82

Name__________

Address__________

City________ State____ Zip____

China Underground

by Myron L. Cohen

Out of China's Earth, by Qian Hao, Chen Heyi, and Ru Suichu. *Harry N. Abrams, Inc., $50.00; 206 pp., illus.*

Written by specialists from the People's Republic of China and lavishly supplied with the excellent photographs they selected, *Out of China's Earth* represents the collaboration of an American publisher and *China Pictorial*. The items illustrated have been carefully chosen, largely on the basis of the high levels of artistic and technical achievement they represent. They also are among the most spectacular of the finds unearthed in China during the period of sustained archeological work since the founding of the People's Republic. The format is that of an art book, with the text mainly dealing with the illustrated objects themselves and providing brief introductions to their social and historical contexts. The finds, shown in excellent color plates, have placed China, especially within the last decade, firmly at the center of the world's archeological imagination.

Of the book's ten chapters, the first seven describe and illustrate objects excavated from a particular tomb or tomb cluster; larger groups of tombs at particular sites are the subjects of chapters eight to ten. With chapters arranged in chronological sequence, the book starts with the tomb of Fu Hao, discovered in the Yin ruins (Shang dynasty) near the modern northern city of Anyang, in Henan Province. Anyang is an appropriate starting place for another reason: here, the techniques of modern scientific archeology, introduced into China only a few years earlier, were employed by Chinese archeologists during fifteen seasons of work beginning in 1928. Although interrupted by the war with Japan (1937–1945), the excavations and analyses by this earlier generation of archeologists confirmed the historical authenticity of the Shang dynasty and made many other important contributions. While digs resumed at Anyang and at other sites shortly after the establishment of the People's Republic in 1949, it was not until 1976 that a fully intact Shang royal tomb—that of Fu Hao, a consort of the Shang ruler Wu Ding—was discovered. Although modest in scale compared with those of other Shang royalty, Fu Hao's tomb alone had escaped the attention of grave robbers, who had been active in the area for centuries. Consequently, the tomb has yielded more objects than any other such Shang structure, including the magnificent bronze and jade articles illustrated in this book. Being a complete collection, the funerary offerings for Fu Hao give us a better idea of the range of techniques and styles during her time; they also provide evidence of the economic resources commanded by individual members of the Shang royalty in life as well as in death. Like other Shang royalty, Fu Hao was interred together with human and animal sacrificial victims, revealing yet another dimension of her power.

Shang (c. 1750–c.1100 B.C.) was followed by the Zhou dynasty (c.1100–256 B.C.), but Zhou overlordship was only nominal, if not totally defunct, by the onset of the Warring States period in 475 B.C. Zhongshan, in modern-day Hebei Province, was one of the smaller states that frequently struggled with its neighbors until finally destroyed in 296 B.C. The second chapter of this book illustrates and describes objects recovered from the tombs of two Zhongshan rulers. In addition to fine examples of large bronze vessels in the characteristic late Zhou style, the gold- and silver-inlaid bronzes are especially attractive. When excavated, two of the bronze vessels still contained wine. Chapter three deals with yet another important Warring States tomb discovered in 1978, this time to the south in Hubei Province. Inscriptions in this tomb identify the occupant as Marquis Yi. Among the many objects of gold, jade, lacquerware, wood, and bamboo illustrated are several kinds of musical instruments and a magnificent set of bronze *bian* bells, intact on its original frame; still another bell is inscribed as having been presented to the marquis in 433 B.C.

The triumph of Qin in 221 B.C. ended the Warring States period and established the first of China's centralized bureaucratic empires. This Qin empire lasted for a mere fifteen years; nevertheless, it marked the initiation of a pattern of imperial rule that was to continue—

with certain interruptions—until the collapse of the Manchu Qing dynasty in 1911. The power of the dynasty, although it ultimately proved intolerable to those under its rule, was expressed, among many other ways, by massive building projects. These included the rebuilding, expansion, and unification of the Great Wall and the construction during his lifetime of an enormous tomb for the first emperor of Qin (Qin Shihuangdi). The mausoleum itself—now appearing as a hill rising above cultivated fields—has yet to be excavated, but historical records describe it as a huge underground palace whose construction required the labor of hundreds of thousands of workers. Built around this massive structure were ancillary vaults, whose precise number, location, and contents are not yet known. It is testimony to the gigantic scale of the Qin mausoleum complex that one of its peripheral structures has excited the world's imagination perhaps more than any other archeological discovery since the opening of the tomb of Tutankhamen. I refer, of course, to the vault of the great terra cotta army of Qin, the subject of chapter four. By now widely known as one of the world's wonders, we need to be reminded that it was first discovered by accident a mere eight years ago. Covering about four acres, the vault contained 6,000 terra cotta soldiers, slightly larger than life size, and six four-horse chariots. The discovery of this vault, now called Pit No. 1, was followed two years later by the finding of Pit No. 2, with 1,400 clay figures of men and horses, and Pit No. 3, with 73 soldiers guarding commanders in a chariot. The discovery of an empty vault, Pit No. 4, suggests that the construction and deployment of the pottery army was interrupted prior to completion.

What are we to make of this army, astonishing not only for the monumentality of its construction but even more so for the marked individuality of many of its soldiers and officers? The army surely represents what in real life was the organized military might with which Qin conquered the contending states and united them into an empire. If the first Qin emperor wished to have his army accompany him to the afterlife it

PRINCESS CRUISES
The Magnificent Adventure

Explore the South Seas this Fall.
Cruise in style to Australia, New Zealand and an array of exotic isles. Places like Tahiti, Fiji, Hawaii, Pago Pago, Bora Bora. Sail California to Sydney and back, or one way. And you'll fly free from major cities.

See a travel agent or send for our Cruiseguide. Princess Cruises, Dept. NHSP42, 2029 Century Park East, Los Angeles, CA 90067.

South Pacific · Alaska · Transcanal · Mexican Riviera · Caribbean

Speak French like a diplomat!

What sort of people need to learn a foreign language as quickly and effectively as possible? *Foreign service personnel*, that's who. America's diplomatic corps assigned to U.S. embassies abroad must be able to converse fluently in every situation.

Now you can make a start on learning to speak French just as these diplomatic personnel do — with the Foreign Service Institute's Basic French Course.

The U.S. Department of State has spent thousands of dollars developing this course. It's by far *the most effective way* to learn French at your own convenience and pace.

The Basic French Course consists of a series of cassettes and an accompanying textbook. Simply follow the spoken and written instructions, listening and repeating. By the end of the course you'll be learning and speaking entirely in French!

This course turns your cassette player into a "teaching machine." With its unique "pattern drill" learning method, you set your own pace—testing yourself, correcting errors, reinforcing accurate responses.

The FSI's Introductory Basic French Course comes in two parts. Part A provides an introduction to the simpler forms of the language plus a basic vocabulary. Part B introduces more complex structures and additional vocabulary.

You may order one or both parts of the Basic French Course:

☐ **Basic French, Part A.** 12 cassettes (17 hours) and 200-page text, $115.

☐ **Basic French, Part B.** 18 cassettes (25½ hours) and 300-page text, $149.

(Conn. and N.Y. residents add sales tax.)

Shipped in handsome library binders.

TO ORDER, JUST CLIP THIS AD and mail it with your name and address, and a check or money order. Or, charge to your credit card (American Express, VISA, MasterCard, Diners Club) by enclosing card number, expiration date, and your signature.

The Foreign Service Institute's French course is unconditionally guaranteed. Try it for three weeks. If you're not convinced it's *the fastest, easiest, most painless way to learn French*, return it and we'll refund every penny you paid. Order today!

Many other FSI language courses also available. Write us.

audio-forum®

**Audio-Forum
Suite 324
On The Green,
Guilford, CT. 06437
(203) 453-9794**

Or visit our New York sales office: 145 E. 49th St., New York, N.Y. 10017 (212)753-1783

Discover Chinese Crafts, Folk Art, and Puppetry!
Our fourth annual crafts tour of China will focus on folk art and traditional puppetry, as well as important classical sites. This unusual educational experience takes you off the beaten track and gives an opportunity to visit folk artists such as peasant painters and the internationally renowned hand puppeteers of Fujian Province. Our tour leader will be Dr. Roberta Stalberg, author of *China's Crafts*, lecturer, and translator. Spaces are limited.
23 days/17 days in China, Aug. 27-Sept. 18. Beijing, Xian, Shanghai, Fuzhou, Quanzhou, Zhangzhou, Xiamen (Amoy), with Tokyo and Hong Kong stopovers. $3519
Address inquiries to Dr. Stalberg, 39A Gramercy Park North, New York, New York 10010. (212) 358-8827

Adirondack Mts.
Lake Champlain
The beautiful Adirondack Mts., located within six million acres of sparkling lakes, picturesque villages and unspoiled wilderness—Essex County—the last of the East's great frontiers.
Essex County Tourism Department
Elizabethtown, NY 12932
Essex County
Olympic County, N.Y.

WOOD
FOR MINIATURES
Mouldings - Panels - Siding - Structural Shapes - Wood Strips - Sheets - Model R.R. Parts
A unique selection of wood materials for miniature needs . . . doll houses, ship models, R.R. cars and mock-ups.
Send $2.00 for a sample packet or self-addressed stamped envelope for catalog.
NORTHEASTERN SCALE MODELS INC. Established 1946
P.O. Box 425NH, Methuen, MA 01844
Telephone (617) 688-6019

Wildlife Tours
Wildlife safaris Tanzania, Kenya, Botswana
Gorilla viewing Rwanda
Andes, Amazon and Galapagos islands
many other trips
Travel with the experts
Adventures International
4421-N Albert St., Oakland, CA
(415) 531-6564

was unlikely—for obvious logistical reasons—that he could accomplish this through the human sacrifices commonly employed by the earlier royalty and nobility of the Shang and Zhou. We may doubt if the constraints were other than pragmatic, for history records that many of Qin Shihuangdi's concubines were interred with him in the main mausoleum. Nevertheless, Qin marks a transition from human sacrifice to the use of images as funerary offerings among China's rulers.

The unity of Qin did not survive the first emperor's death in 210 B.C., but after a brief period, imperial unity was reestablished in 206 B.C., with the founding of the Han dynasty. Qin bequeathed to Han and later dynasties not only an imperial bureaucratic system—copied, modified, and developed through the centuries—but also national standardization in many areas. Of major importance was the standardization of the written language under Qin auspices. The well-known inscriptions on Shang and Zhou oracle bones, shells, and bronzes give evidence of the steady development of writing and its movement away from the more cumbersome earlier forms, whose components were based on relatively direct pictorial representation, toward simpler, reduced, and more standardized forms of characters. The further simplification under Qin resulted in the so-called small seal script; additional modifications during Han created the standard form of written Chinese still used by many Chinese today (in the People's Republic partial replacement of the standard form with additionally simplified characters began in the 1950s). Nevertheless, the major transformation of written Chinese is marked by small seal script, from which all subsequent developments derive.

Chapter five illustrates finds from the three Western Han tombs discovered and excavated between 1971 and 1974 at Mawangdui, near modern Changsha (Hunan Province). Among many other treasures, these tombs have yielded writing on silk and on bamboo strips. These documents are all in standardized script; since it is known that Tomb No. 3 dates from 168 B.C., we have impressive evidence of the impact of the language reforms introduced during the Qin dynasty, which had come to its end only fifty-three years earlier. Tomb No. 3's silk books amount to about 120,000 Chinese characters and include more than twenty titles: most are copies of works on a wide variety of topics, including astronomy, medicine, history, and government. With these books were the earliest examples of Chinese maps found so far. The recovery of these lost works has vastly expanded our knowledge of the Western Han and earlier times, but perhaps equally important was the discovery of ancient versions of texts that were preserved in the historical records—texts such as the Dao De Jing (Taote Ching) and the Book of Changes. These finds confirm the authenticity of the surviving classics, even though there are differences between the extant versions and those found at Mawangdui.

Tomb No. 2 was the first to be built; plundered several times, it nevertheless yielded evidence that it once contained the body of Li Cang, the first marquis of Dai, who was given his title by the Han emperor in 193 B.C. The other Mawangdui burials, however, are the best preserved of all the hundreds of Han tombs so far discovered. Li Cang's wife, in No. 1, probably lived to see her son's 168 B.C. burial in No. 3. Among the items recovered from the intact tombs was the body of Li Cang's wife, in a remarkable state of preservation, and a large amount of fine lacquerware and silk, including two silk funerary paintings illustrating early Han conceptions of the afterlife. The paintings confirm that the Chinese had well-developed ideas of heaven and hell prior to the penetration of Buddhism; although this finding is not surprising, given what we know about other societies in the world, it does contradict a body of earlier scholarly opinion.

Finds from the Western Han tombs of Liu Sheng (died 113 B.C.), the son of Emperor Jing Di, and Liu's wife Dou Wan are the subjects of chapter six; these objects make up yet another group of well-known "classics" of modern Chinese archeology. Discovered in 1968 in Hebei Province, the tombs contained the famous jade burial suits and a collection of exquisite bronze vessels, including the Changxin lamp with servant girl and the gold-inlaid bronze incense burner in the shape of the Isle of Immortals. The remains of horses, sacrificed and placed in the tombs with their chariots, indicates the survival of a practice (although it no longer involved people) well established during Shang.

A later, Eastern Han tomb in Gansu Province provides material for chapter seven. Found in the tomb, which was the resting place of a General Zhang, were some 200 objects, about half of which made up a procession of bronze horses, mounted horsemen, escorts, chariots, carts, drivers, and attendants. Both the composition and the artistic excellence of this group of figures, which includes the magnificent "horse and swallow," are believed by the authors to reflect the tomb's location in an area on the famous "Silk Road" linking China and the West. Among the many goods traded in both directions, fine horses from Central Asia were especially desired by the Han empire for its cavalry. Living in the very same Central Asian regions that supplied China with horses were nomadic pastoral and hunting peoples who posed the dangers that the Han cavalry was organized to deal with. These various peoples, collectively known to the Chinese as the *Hu*, are called the Huns in chapter eight, which illustrates and describes their works and those of the ethnic Chinese who lived among them. These articles and paintings, from different sites, are now in the Museum of the Inner Mongolian Autonomous Region. Golden and bronze objects from China's Warring States period show Central Asian styles and motifs; the later expansion of the Chinese empire into the region is illustrated in the tomb of an Eastern Han governor, where a wall painting shows him taking up his post.

With the collapse of the Han dynasty in A.D. 220, China entered into a sustained period of disunity followed, once again, by reunification under the short-lived Sui dynasty (581–618) and then under the long-lasting Tang (618–907). Although China was to experience additional, shorter periods of division, Sui-Tang marks the onset of that long and final phase of premodern China's history, when the dominant theme was sustained unity under a succession of imperial dynasties. Chapter nine returns us to Changan (Xi'an) when it was the Tang capital, and includes photographs of some of the finest examples from the collections of three-colored pottery held by Xi'an's different museums and institutions. These characteristic Tang ceramics were found in different tombs in Xi'an's vicinity and are noteworthy not only for their beauty but also for the indications they provide of China's flourishing trade and contacts with Central Asia, Persia, and countries farther west. Some of the ceramics show Western stylistic influences, while others depict individuals with Central or West Asian physical features. Our sense of Changan's cosmopolitan culture is further enhanced by two caches of gold and silver vessels discovered in 1970. Buried to be retrieved by the living, rather than for the dead, these elegantly engraved, hammered, and gilded objects include bowls, cups, trays, and jars that show a strong Persian influence.

One of the important Silk Road routes linking Changan to Central Asia and beyond passed through the ancient town of Turpan (Turfan), in present-day Xinjiang. The ruins of ancient Turpan, a settlement that flourished as a transit and trading center and as a productive oasis from Han to Tang, can still be seen, about twenty-five miles southeast of the modern town. This book's last chapter presents examples of the finds yielded by the excavation of some 400 tombs found next to the villages of Astana and Karakhoja on the outskirts of Turpan. Earlier in this century, Sir Aurel Stein had carried out excavations there and reported considerable grave plundering; thus the finds of the Chinese archeologists are all the more impressive. These include plain silks, brocades, and printed silks produced during the fourth to seventh centuries and unmatched in quantity, quality, and variety by yields at other sites. The silks show Chinese, Central Asian, and Western designs, while the silk paintings and clay and wooden figurines found in some of the tombs are done in Tang style. A variety of Tang documents have also been recovered; used in the tombs as waste material for stuffing and for mortuary clothing, they provide important data on the social, political, and economic affairs of the area.

Since this book provides only a small amount of supplementary information, additional reading will be required for those wishing to know more about the historical background of the sites. Also, since most of the objects dealt with by the text were found in the tombs of members of China's ruling strata, the lives of the common people are scarcely touched upon. A bibliography of relevant literature would have been useful.

There are a few errors of transliteration in the text, such as Be Si instead of Bao Si; also, Gao Zhong, Zhong Zhong, Xuan Zhong, and Tai Zhong should be Gao Zong, Zhong Zong, Xuan Zong, and Tai Zong. Such minor errors, however, do not detract from the attractiveness of this excellent art volume, which very successfully accomplishes its goal of illustrating the finest of China's archeological treasures.

Myron L. Cohen is a professor in the Anthropology Department and East Asian Institute at Columbia University. His research and teaching speciality is Chinese society.

NATURAL HISTORY MAGAZINE BINDER

The functional way to save your full year's issues for future reference and pleasure. "Natural History" stamped in gold color on dark green leatherette over heavy binder's board 12¾" x 9". Price $6.50. Members $5.85.

American Museum of Natural History
Museum Shop
Dept. 229
C P W at 79th St.
N Y, N Y., 10024

Qty	Price	Shipping/ Handling	Total
		$2.00 ea.	
		Order Total	
		N Y. Sales Tax	
		Total Amount	

Enclosed is check/money order for $ ______

Name

Address

City State Zip

Treasures From The Earth

Color Portfolio of Natural Specimens and Catalog of Minerals, Display Stands, Books and Natural Jewelry, $3.00

Dover Scientific
Box 6011C Long Island City, NY 11106

For many years we have been honoured to arrange tours to unusual destinations for the friends of the ***Dallas Museum of Natural History,*** *led by Mr. Steve Runnels, its Curator of Ornithology.*

TETIAROA

Participation in the tour to the South Pacific on October 8 to 18, 1982 is available to all members of the public and includes visits to Tahiti and Bora Bora, and four days on Mr. Marlon Brando's idyllic private atoll of Tetiaroa with its remarkable marine life and bird sanctuary.

Detailed dossiers of this exceptionally interesting nature tour are available at $2 from:

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

BOOK HUNTING?
Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: BOOKS-ON-FILE
Box 195 Dept. 72
UNION CITY, NEW JERSEY 07087

CELEBRATION
Asia's spectacular and colorful festival—the Perahera celebrated in honor of the Buddha in the jewel island of Sri Lanka. Join us on a tour for the Perahera and to see also splendid architecture and sculpture of medieval cities, wild life, the hill country, coastal villages and arts and crafts centers. Extensions to Kashmir, the Taj Mahal, Nepal and to South India's temple area are available.
For brochure write or call:
JOURNEYWORLD
155 East 55th Street, New York, NY 10022
Tel: (212) 752-8308

The Wilderness Travel
World of Discovery

SUMMER/FALL NATURE TOURS to:
• CHINA • East Africa • Europe •
• Galapagos • Alaska • Australia •
• The Amazon • Ecuador • Peru •
Expert naturalist leaders Very small groups
Write for free illustrated catalog
WILDERNESS TRAVEL
1760-NB Solano Avenue, Berkeley, CA 94707
(415) 524-5111

SAVE 33%
WHEN YOU ASK FOR MORE ALASKA

Cruise the Inside Passage with TravAlaska and save up to 33% by choosing the economical Alaska Ferry. Or experience the luxury of a cruise ship or new mini-cruiser. And for the first time, you can choose a dollar-stretcher itinerary that shows you the Best of Alaska *and the Canadian Rockies* in one scenery-packed trip.
YOU CAN'T ASK FOR MORE ALASKA THAN TRAVALASKA
TravAlaska
TravAlaska Tours
Fourth & Battery Bldg., Suite 555
Seattle, WA 98121
Please send me your free brochure on Alaska and the Canadian Rockies NH4
Name ____
Address ____
City ____
State ____ Zip ____

The Inconstant Sun

New satellite data show small changes in the amount of solar energy coming toward the earth

by Stephen P. Maran

After more than 150 years of studying the so-called solar constant, astronomers have concluded that it isn't constant after all. Definitive measurements made from a NASA satellite show that magnetically disturbed regions on the sun produce the changes.

The solar constant is defined as the total energy received from the sun in all wavelengths of light in one second on an area of one square meter (about 1.2 square yards), located at the earth's average distance from the sun. Thus, it is a measure of the amount of visible, infrared, ultraviolet, and other forms of sunlight received at the earth, but adjusted to eliminate such complications as interference by our atmosphere and changes in distance from the sun as the earth travels its elliptical orbit.

The solar constant should not be confused with the solar luminosity. The latter is the amount of energy actually emitted by the sun each second. Astronomers have generally assumed that a change in solar luminosity produces a corresponding change in the solar constant. Thus, an increase of one-tenth of one percent, for example, in the energy emitted by the sun would produce an equal percentage rise in the solar constant. This assumption may be right, but the reverse is wrong: a change in the solar constant is not necessarily caused by a change in the solar luminosity. In fact, the satellite data indicate that the most pronounced changes in the solar constant are due to variations in the amount of sunlight coming *toward the earth*, not to changes in the total amount of light going out in all directions from the sun.

The NASA satellite previously mentioned is the Solar Maximum Mission, or SMM for short. SMM, with a battery of instruments to study solar radiation, was launched into orbit around the earth on Valentine's Day in 1980. Many valuable observations, including measurements of the solar constant, were obtained over a ten-month period, before the satellite's precision-pointing capability was disabled. NASA may yet schedule a space shuttle flight so that astronauts can repair the disabled satellite. Meanwhile, limited observations continue and data from 1980 have been subjected to exhaustive analyses.

The SMM measurements of the solar constant represent the culmination of literally dozens of studies done since 1827, when the English astronomer Sir John Herschel made the first instrument for such measurements. Herschel later made a long series of observations from South Africa and determined a value for the solar constant that is within 10 percent of the best modern estimate.

Since Herschel's time, many other scientists have studied the solar constant and refined his value to greater accuracy. There has been much disagreement, however, as to whether the solar constant is stable or subject to small variations. Although some investigators did report that variations occur, they failed to agree on the magnitude of the changes and on their time dependence. Some purported variations in the solar constant were said to be periodic, so that the sun supposedly brightens, fades, and brightens again in regular cyclic fashion like a pulsating variable star. But even those astronomers who claimed to observe such a cycle disagreed on its length. According to some investigators, the cycle length is 11 years, matching the sunspot cycle, but others found that the length is 8¼ years or even 22¾ years.

The disagreements were not due to an inadequate quantity of data. Literally tens of thousands of measurements were taken of the solar constant; one tabulation prepared in the days before electronic computers was said to be "15 inches wide and 200 feet long." Rather, the conflict between the results of various astronomers was due to the inherent difficulties in obtaining reliable data. Many properties of the atmosphere affect the amount of solar radiation that is received on the ground: two examples are the amount of water vapor and the number of aerosol particles, two quantities that are notoriously variable from place to place and from day to day.

Further, if a variation in the solar constant not traceable to atmospheric effects was found, the responsible scientist had to prove that the apparent variation was not due to a change in the sensitivity of his instrument but to a change in the light from the sun.

Attempting to eliminate the effects of changing atmospheric interference, investigators of the solar constant climbed the Alps and other high mountains and also made measurements in the clear skies over deserts. They launched instruments to even greater altitudes on balloons and sounding rockets and mounted some sensors on weather satellites and interplanetary space probes. Nonetheless, even well into the 1970s, the stability of the solar constant remained an open question. Some astronomers found that changes do occur, and others reported that, to the limits of measuring accuracy, there are no such changes.

The longstanding concern of so many scientists with the solar constant and its possible variations is not a matter of pure academic interest. Such variations have potential impact on the climate and the weather. In 1978 a symposium on this subject at Ohio State University in Columbus concluded that "sun–weather relationships may extend from days to thousands of years." If the solar constant changed in a systematic way, even at a very low rate (say, a decrease of a small fraction of one percent per year), severe effects on climate and food production would eventually result, or so say leading climatologists. I am not overawed by these experts as at least one of them thoroughly confused the solar constant and the solar luminosity in a recent book, but their ideas merit serious consideration. Further, some atmospheric scientists believe that small variations in solar radiation can have immediate consequences for the weather in local regions, through poorly understood atmospheric processes that allegedly amplify the effects of the radiation changes.

Other scientists have asserted that variations in solar ultraviolet and X-ray radiation may trigger weather phenomena, even though the amount of ultraviolet and X-ray energy from the sun is negligible compared with the solar constant as a whole, which is dominated by strong visible and infrared light.

A basic aspect of physics is also involved in studies of the solar constant. Changes in the constant, if such occur, must result either from like changes in the solar luminosity (in which case they provide basic physical data on energy generation within the sun) or from phenomena involving the way in which energy is released from the solar surface. In either case, solar physicists are very interested.

An instrument operating aboard SMM above the earth's atmosphere has settled the question of whether the solar constant varies. The constant was found to vary from day to day and from week to week, although by very small amounts. This unprecedently precise instrument, called an active cavity radiometer irradiance monitor and known by the acronym ACRIM, was designed by Richard C. Willson, a veteran student of the solar constant, who works at the Jet Propulsion Laboratory in Pasadena, California.

ACRIM comprises three independent sensors, each individually capable of measuring the solar constant. Thus, the data from any one of the sensors can be checked against those from the other two. This enables researchers to eliminate bad data points due to a problem in any one sensor. ACRIM has proved capable of measuring a change in the solar constant as small as an increase or decrease of one-thousandth of one percent in ninety minutes. To ACRIM's delicate sensors, the sun seemed to brighten and fade dramatically each time SMM orbited around the earth, since on one side of the earth the satellite was closer to the sun (and thus ACRIM recorded a higher brightness) than on the other. Even the direction of the satellite's motion affected the precision readings: When going toward the sun, ACRIM recorded a higher solar

The World 'n General

GENERAL TOURS
takes you to
CHINA
IN
GREAT STYLE
14-19 days from $1099*
plus airfare

FANTASTIC VALUE —
— MODERATE PRICE!

General Tours now offers FIVE CHINA PROGRAMS for 1982 PLUS Southeast Asia extension to Bangkok and Singapore on our Grand Orient Tour.

- wide-body jets
- American tour manager
- easy pace for maximum enjoyment
- all meals in China
- full sightseeing
- East/West Coast departures
- outstanding itineraries— many featuring Xian and Kweilin
- Unique Russia-China combo
- HAPPY TRAVEL gift
- many extras

*per person double occupancy from NY

MEMBER ASTA American Society of Travel Agents
USTOA
MEMBER Pacific Area Travel Association

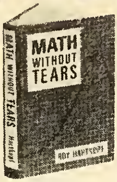
Member of the First Family of Travel

What A Way To Go!

GENERAL TOURS, INC.
711 THIRD AVE.
NY,NY 10017
212-687-7400 NH482

YES! TAKE ME TO CHINA IN GREAT STYLE! Please send my free copy of
☐ THE CHINA BOOK
name ______
address ______
______ zip ______
my travel agent: ______

MATH WITHOUT TEARS



Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written.

Learn math in the comfort of your own home at minimum cost.

Order Now $11.95 plus $1.25 hdlg
EMERSON BOOKS, INC.
Dept. 423-G, Verplanck, NY
10596
10 Day Money Back Guarantee

For the eighth year, we invite adventurous travelers to join us on our fascinating

Naturalist's Safari in Rajasthan

NOVEMBER 20 TO DECEMBER 12, 1982

with three days at TIGER HAVEN in Uttar Pradesh and attendance at the PUSHKAR CAMEL FAIR by full moon.

This tour of Northern India is designed for people whose interests lie in watching and photographing animals and birds in their natural surroundings, riding elephants and walking in unspoiled countryside.

In Delhi, Agra and the great palace cities of chavalric Rajasthan — Jaipur, Jodhpur and Udaipur — we stay in deluxe hotels; accommodations on safari are at lodges in lovely wildlife parks and under canvas in the sandstone hills of the desert.

Detailed brochure available from:

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

For Those Special Moments...
INTIMIQUE™

A Unique Collection of Luxurious Designer Lingerie!

Indulge yourself with our lacy, elegant camisoles, French pants, bra and panty sets, teddies, gowns and other luxurious lingerie from fine designers like Montenero, Stillman, Loré and others.

Send $2.00 to receive our exclusive Catalogue of Designer Lingerie. Mail to Intimique. Dept. 942 One Eastwood Drive, Cincinnati, Ohio 45227.

brightness than at the same distance from the sun but on the opposite side of SMM's orbit as the spacecraft receded from the sun. Such an effect is predicted by physical theory but is so small that it has rarely been observed. Artificial variations in the apparent solar constant, induced by the aforementioned effects of the satellite's motion and position and by other known causes, had to be discounted in Willson's investigation. Once that was done, he found that the true changes in the solar constant amounted to as much as two-tenths of one percent.

Striking dips in the solar constant of the above magnitude occurred in early April and late May of 1980. In each case, the dip accompanied the passage across the central meridian (north-south line) of the solar disk of a large sunspot group. Sunspots are the dark pockmarks that come and go on the sun and that correspond to regions of strong, disturbed magnetic fields.

Since sunspots are darker than the solar surface, you will hardly be amazed to know that they cause decreases in the amount of sunlight received at the earth. Nevertheless, the decrease in sunlight due to sunspots (which has been confirmed by measurements with the weather satellite Nimbus 7) raises the question, "Where does the missing energy go?" There may be a dip in the solar constant due to a sunspot group, but the sun's energy is generated deep in the star's core, a region wholly insensitive to magnetic fields or other disturbances at the surface. Energy generated within must emerge at the surface, whether dark spots are present or not. Yet a mathematical analysis by Hugh S. Hudson, a noted solar physicist at the University of California, San Diego, demonstrated that the changing areas of the umbrae (dark central regions of sunspots) and penumbrae (less dark outer regions) of the April–May 1980 sunspot groups corresponded very closely to the time profiles of the solar constant dips measured by ACRIM. Thus, the sunspot groups surely caused the dips. Astrophysicist Sabatino Sofia, a colleague of mine at the Goddard Space Flight Center, explains that the "missing energy" of the dips must either have been stored beneath the solar surface for a period of time (presumably by some magnetic process) or have been beamed from the sun in such a way that it missed the earth and the ACRIM sensors.

One idea about the missing energy was that it might emerge from the sun in a fairly narrow "bright ring" around the sunspots. Such bright rings have occasionally been reported by astronomers in past years. However, Hudson's analysis of the ACRIM measurements showed that no significant bright ring was present. Since such a ring is larger than the sunspot, one side of the ring would cross the central solar meridian before the sunspot and should produce a brief peak in the value of the solar constant, just before the dip due to the spot. The other side of the ring would cross the meridian after the sunspot and therefore should cause a second peak just after the dip. But no such peaks were found. Another suggestion was that the missing energy might be emitted from some place on the sun not subject to ready observation, such as the back side or one or both of the poles. But there is no physical reasoning to support this idea.

The correct explanation for the missing energy, which is not missing after all, comes from two recent studies by Sofia and two Goddard associates, Ludwig Oster and Kenneth Schatten. At least, they have convinced me. The trio investigated the role of faculae (from the Latin, "little torches") on the sun.

Faculae are fairly large regions of weak, disturbed magnetic fields that surround sunspot groups and that are sometimes also present when sunspots are not. (For example, faculae usually persist after the associated sunspots have died out.) Astronomers have studied faculae for generations, but found few basic facts. One striking fact that was found, however, is that faculae (which are slightly brighter in visible light than the undisturbed solar surface) are hardly visible when near the center of the solar disk, but are readily seen when near the solar limb. (The limb is the apparent edge of the sun as viewed from the earth.) Yet faculae surely are present at the disk's center, since there is no physical reason for them to die out briefly as they pass the center.

Earlier studies suggested that the total light of the faculae associated with a sunspot group is notably less than the amount of light required to "bring up" the spot group to the average brightness of the undisturbed sun. Thus, at first glance the faculae seem an unlikely candidate to explain the missing energy of the solar constant dips. Nevertheless, Oster, Sofia, and Schatten made use of the above-described dependence of faculae visibility on solar position to prove that the faculae do indeed account for the missing energy. Apparently, faculae do not shine primarily upward like a normal part of the solar surface, but off at an angle, like a bank

Again, we're only $15 a year

HISTORY REPEATS ITSELF

NATURAL HISTORY
$2

NATURAL HISTORY Magazine is published by the American Museum of Natural History, New York, N.Y. Please allow 7 weeks for delivery of first issue. Outside U.S. please add $5 per year for postage.

History repeats itself in the new year by offering you membership in the Museum of Natural History and 12 galvanizing issues of NATURAL HISTORY Magazine at last year's low price of just $15.

☐ YES, send me 12 months of NATURAL HISTORY for just $15 (I save $9 over the newsstand rate) and my museum membership which is included in my subscription.

NAME____
ADDRESS______________________________________
CITY____________________ STATE____________ ZIP________

Include a gift membership for:

NAME____
ADDRESS______________________________________
CITY____________________ STATE____________ ZIP________

I PREFER TO INCREASE MY SAVINGS AND ENJOYMENT: J543
☐ Send 2 years at $26 ☐ Send 3 years at $35

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

Postage will be paid by addressee

NATURAL HISTORY
P.O. Box 4200
Bergenfield, New Jersey 07621

In 1974 we originated our epoch-making ***Galapagos Islands Thrift Cruises****, which for several years enabled many hundreds of budget-minded travelers who were interested in ecology, wildlife and photography to see these unique islands without luxurious trimmings but under expert guidance.*

We now again offer a budget program which includes some of the highlights which make a visit to this remarkable archipelago such a renowned tourist attraction. We explore five of the islands in order to view sea lions, iguanas and a large variety of birds, such as the famous Darwin's finches, boobies, frigates and gulls:

Galapagos Islands Thrift Program

APRIL 4 TO 14, 1982
JUNE 27 TO JULY 7, 1982
DECEMBER 26 TO JANUARY 5, 1983

Our program includes easy hikes on Santa Cruz to see tortoises roaming free and to the top of the dormant volcano at Sullivan Bay, and ample opportunities for swimming and snorkeling. It is ideal for young people and families with children and has been planned during periods of school and college vacations.

We do not claim that these programs are as comprehensive as our superb and unrivalled **Discover Galapagos** yacht cruises in August and October, 1982; but our meticulously supervised arrangements do provide you with a fascinating introduction to these wonderful islands—and at a third of the cost.

Each program is accompanied by one of our expert leaders and a naturalist guide who give informative talks and lead us in the field.

Before the week at the islands, we spend two days at the best hotel in Quito, Ecuador's lovely capital in the Andes.

Please send for the detailed brochure of these programs—we also specialize in expeditions to Greenland, Mount Kilimanjaro, the Himalayas and the Andes; wildlife safaris to see polar bears and seals in northern Canada and to Scotland, Borneo and Rajasthan; and archaeological tours to Peru, Morocco and Egypt.

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

POLAR BEARS
of Hudson Bay
Photography, Natural History
October 17-25, 1982
ALASKA WILDLIFE
Pribilofs, McKinley, Glacier Bay
July 10-27, 1982
ARIZONA BIRDING
Southeast Canyonlands
August 14-25, 1982

JOSEPH VAN OS
NATURE TOURS
Box 655 Vashon Island
Washington 98070
206-463-2724

of footlights on the Broadway stage. We see sunspots most prominently near the center of the solar disk, since perspective foreshortens them near the limb. But when spots are near the disk center, so are their associated faculae. Since the faculae beam their light off to the side, it doesn't reach the earth and is thus not measured by our instruments. This explains why the earlier studies mentioned at the outset of this paragraph may have led to misleading results. Another contributing factor may be that faculae outlive their associated sunspots. Perhaps some of the missing energy associated with the sunspots is stored beneath the solar surface and is slowly radiated away over the lifetime of the faculae.

To see if the faculae associated with a sunspot group release energy comparable to the dips in the solar constant, we have to measure the light of the faculae when they near the solar limb, so that they are shining toward the earth. Numerical simulations of those conditions by the Sofia team indicated that the missing energy is indeed emitted by faculae and therefore isn't "missing." Using a numerical model based on the first ACRIM measurements, Sofia, Oster, and Schatten succeeded in calculating the changes in the solar constant for the latter part of 1980 before the corresponding ACRIM measurements became available. The model used ground-based telescope measurements of the sizes and locations of sunspots and faculae. In effect then, after 150 years we have now not only confirmed that there are variations in the solar constant but we have also learned what causes the most pronounced kinds of variations that have been found.

The story of the solar constant is not finished. As determined by ACRIM, the most obvious changes in the constant result from solar "skin effects," involving the subtraction of outward-flowing solar energy by sunspots and its redirection (possibly after an interval of subsurface storage) by faculae. Now that we can account for these effects, we can scrutinize solar constant measurements for trends that, although weak, may produce substantial changes over long periods of time. Such trends, if they exist, would reflect real changes in solar energy generation that could affect our climate on Earth.

Stephen P. Maran is a senior staff scientist in the Laboratory for Astronomy and Solar Physics at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

Better Than Jogging

NordicTrack

Jarless Total Body Cardiovascular Exerciser
Duplicates X-C Skiing for the Best Motion in Fitness

Highly Effective and Pleasant To Use
The enjoyable sport of cross-country skiing is often cited by physiologists as the most perfect form of cardiovascular exercise for both men and women. Its smooth, fluid, total body motion uniformly exercises more muscles and higher heart rates seem easier to attain than when jogging or cycling. NordicTrack closely simulates the pleasant X-C skiing motion and provides the same cardiovascular endurance-building benefits — right in the convenience of your home. Makes a year round, consistent exercise program easily attainable. Eliminates the usual barriers of time, weather, chance of injury, etc. Also highly effective for weight control.

Better Than Running
NordicTrack gives you a more complete work out — conditions both upper body and lower body muscles at the same time. Fluid, jarless motion will not cause joint or back pains as jogging or running often does.

Better Than Exercise Bikes
NordicTrack's stand-up skiing motion more uniformly exercises large leg muscles and also adds important upper body exercise. Higher pulse rates, necessary for building fitness, seem easier to attain because the work is shared by more muscle mass. The NordicTrack also keeps more muscles in tone.

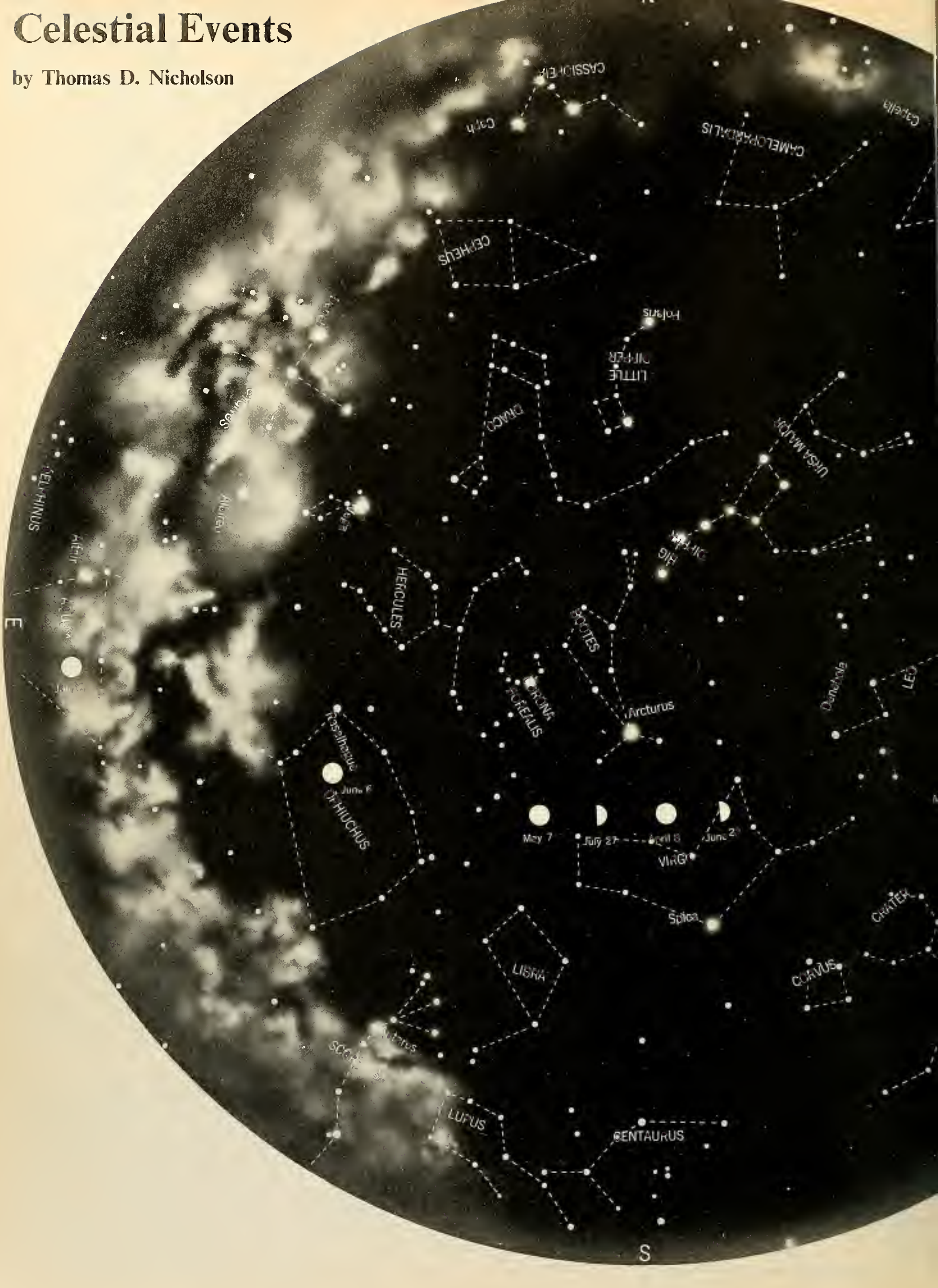
Even Better Than Swimming
NordicTrack more effectively exercises the largest muscles in the body, those located in the legs and buttocks. These muscles' main function is to lift and propel the body in the standing position. However, when swimming, the body is supported by the water, thus preventing these muscles from being effectively exercised. The stand up exercising position on the NordicTrack very effectively exercises these muscles.

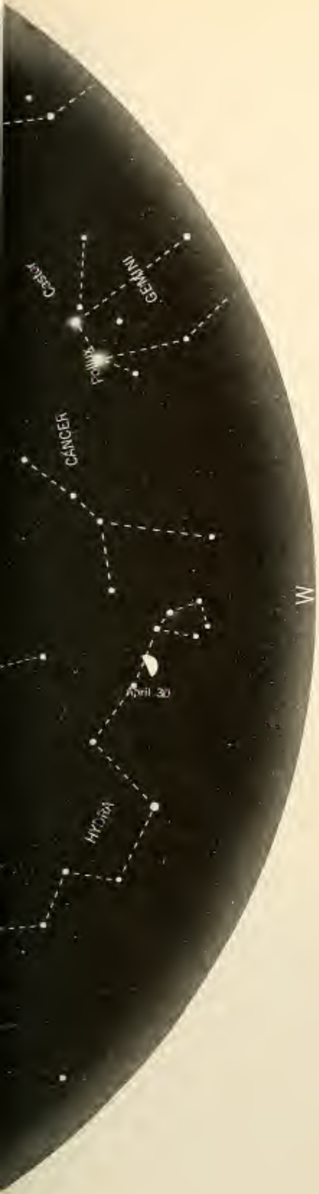
A Proven, High Quality Durable Product
Ruggedly constructed, NordicTrack is quiet, motorless and folds compactly for storage. Separately adjustable arm and leg resistances. NordicTrack is in its 5th year of production and is used in thousands of homes and many companies. We manufacture and sell direct. Our No-Risk 15 day trial guarantee shows our confidence in your being pleased with the performance and quality of the NordicTrack.

For more information, call or write
PSI 124 L Columbia ct. Chaska, MN 55318
toll free 1-800-328-5888 8 – 5 Mon – Fri
Minnesota 612-448-6987

Celestial Events

by Thomas D. Nicholson


CASSIOPEIA
Caph
CAMELOPARDALIS
Capella
CEPHEUS
Polaris
LITTLE DIPPER
DRACO
URSA MAJOR
BIG DIPPER
Vega
Albireo
DELPHINUS
Altair
AQUILA
E
July
HERCULES
BOOTES
CORONA BOREALIS
Arcturus
Denebola
LEO
Rasalhague
June 6
OPHIUCHUS
May 7
July 27
April 8
June 2
VIRGO
Spica
CRATER
CORVUS
LIBRA
Antares
SCORPIUS
LUPUS
CENTAURUS
S



All Month The skyful of morning planets from last month falls apart in April. The process actually begins on the last day of March, when Mars moves into the evening sky. Then in April, Saturn, Mercury, Pluto, and Jupiter follow suit. Whereas *all* the planets were morning stars in March, by the end of April we have only three left, Venus, Uranus, and Neptune.

The change doesn't really make all that much difference in the appearance of the most prominent planets from this winter. Venus stays in the morning sky, still brilliant, rising several hours before the sun, but remains low throughout the morning twilight. When morning skies are clear, Venus can still be easily seen low in the east from daybreak on, even though it is well past maximum brilliancy.

Mars, Jupiter, and Saturn continue to present an imposing alignment of bright objects in Virgo, near its brightest star, Spica. Shifting into the evening sky, they are better, if anything, because they are visible virtually all night long throughout April.

April 1: First-quarter moon. The two bright stars to the left and above the moon are Pollux (the brighter) and Castor, the twin stars of Gemini. Venus is at its greatest distance to the right of the sun (greatest westerly elongation).

April 3–4: The bright star near the moon is Regulus, in Leo.

April 5: Mars is nearest the earth during this cycle of configurations. The planet was in opposition from the sun on March 31. Now at its brightest, Mars dims significantly during the next two months as its distance from Earth rapidly increases. The distance from Earth to Mars today is about 59,000,000 miles.

April 6–7: The bright gibbous moon (almost full) passes from right to left above Mars. Conjunction of moon and planet occurs at about 8:00 A.M., EST, on the 7th.

April 8: Full moon. The two bright objects nearest the moon tonight are Saturn (above) and Spica (below), the brightest star of Virgo.

April 9: Saturn is at opposition from the sun, rising at sundown and setting at sunrise. On successive nights after this, the planet will be above the horizon at sunset, but not at sunrise. This makes it technically an "evening" star even though it is still about equally prominent at dawn and dusk.

April 11: Mercury is in superior conjunction, in line with but beyond the sun as observed from Earth. The planet now moves from west to east (right to left) past the sun, taking it into the evening sky.

April 11–12: The bright reddish star south of the moon on these nights is Antares, in Scorpius. The moon moves eastward past Antares on the morning of the 12th.

April 13: The moon is at apogee, farthest from the earth.

April 14: The waning gibbous moon is in Sagittarius.

April 16: Last-quarter moon.

April 20: The very bright object you can see near the slim, waning crescent moon this morning is Venus. The moon is near the vernal equinox today, the point where the earth's orbital and equatorial planes meet in the sky and where the sun is located when spring begins in the Northern Hemisphere.

April 22: The Lyrid meteor shower reaches maximum this morning.

April 23: New moon.

April 25: The moon is at perigee, nearest to the earth. Communities that shift their clocks to daylight time advance one hour this morning.

April 25–26: You may see the very young crescent moon in the evening twilight on the 25th, with the reddish star Aldebaran, in Taurus, to its left. The crescent should be easily visible on the 26th, with Aldebaran more distant to its right.

April 26: Jupiter is at opposition from the sun and enters the evening sky, the third of the three bright planets in our nighttime sky to do so within the past few weeks.

April 30: First-quarter moon. The star nearby is Regulus, in Leo.

The spring Sky Map shows the sky for the months of April, May, and June from latitude 40° north at the evening hours given below. To use the map, hold it vertically in front of you with the north (N) at the bottom, and match the lower half of the map with the stars you see when you face north. As you face in other directions, roll the map to bring the corresponding compass direction to the bottom of the map.

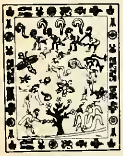
The stars move west continuously during the night. By morning (before dawn) stars on the western half of the map will have set, those on the eastern half will have moved into the west, and new stars (those of the spring evenings) will have risen in the east. The map represents the sky at about 2:00 A.M. on April 1; 1:00 A.M. on April 15; midnight on April 30; 11:00 P.M. on May 15; 10:00 P.M. on May 31; 9:00 P.M. on June 15; and 8:00 P.M. on June 30. Add one hour for daylight time. The map can be used for an hour or more before and after the times given.

Art

AMERICAN INDIAN CRAFTS: Southwest Indian pottery, baskets, rugs, kachinas. Northwest Coast Indian masks, totems, graphics. Eskimo sculpture. No catalog. One-of-a-kind pieces, individually photographed. Priced $100/up. Photos and data available. Specify interests. Box 5896, Sherman Oaks, CA 91413. (213) 789-2559

AUTHENTIC INDONESIAN DANCE MASKS, $30-$90, request photos, McCoy Imports, Liberty, NY 12754

MADAGASCAR ARTS/CRAFTS Handcrafted Antaimoro floral paper/stationery Send $2.00 for sample notecard refundable first purchase. Write Indian Ocean Imports, Box 249, Williamstown, MA 02167



Pre-Columbian Collectibles!

PARADISE OF TLALOC (200 B.C.-A.D. 900), the Mexican rain God of the Aztecs—only one of many original sengraphs and rubbings of Aztec and Maya ruins! Complete color catalog $2 (deductible with order).

BERNARDO
2400 Westheimer Suite 108W (NH2)
Houston, TX 77098

Book Publishers

BOOKFINDING. Librarians search worldwide titles or subjects plus 150,000 indexed stock. PAB, 2918 Atlantic, Atlantic City, NJ 08401 (609) 344-1943

YESTERDAY'S BOOKS LOCATED, no obligation. Out-of-State Book Service, Box 3253J, San Clemente, CA 92672 (714) 492-2976

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHP, 84 Fifth Avenue, New York, NY 10011.

Books

BIRD BOOKS, OTHER NATURAL HISTORY. Rare, Out-Of-Print, Color Plate. Catalogue $2.00, Books Bought. Larry J. Rueseck, Blue Ridge Road, Schroon Lake, NY 12855

FOLLOWING THE FOOTSTEPS OF STEPHENS-CATHERWOOD. Their 1840 Mexican travels! Original drawings/new photography. English/Spanish. 273 illustrations. Hardback, $20. Bernardo's, 2400 Westheimer, Houston, Texas 77098

ORNITHOLOGICAL books, scarce, out of print, rare. Natural history color plate Catalogues $2.00. Book Chest, 19N Oxford Place, Rockville Centre, NY 11570

PLANT LORE. Illustrated semiannual—exotica, news, medical uses, folklore, mysticism, magic. $6.00/yr. 16N Oak, Geneseo, NY 14454

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalogue: Hamilton's, 98-55 Clapboard, Danbury, CT 06810

THE OTHER AMERICANS: Living in Emerging Alternative Lifestyles; 250 pages, 8½ × 11, 30 papers/talks by sociologists, psychologists, lifestyle leaders, from annual Lifestyles Convention. $10.95 postpaid to: Lifestyles, 2742-A W. Orangethorpe, Fullerton, CA 92633

Collectors' Items

BIRDS, ANIMALS OR FLOWERS on postage stamps from many countries. 25 different 35¢. George Ford, P.O. Box 5203-N, Gulfport, FL 33737

NATIONAL GEOGRAPHICS 1888-1982, issues Book Publications, Collectors Items, Send Wants Buxbaum Geographics, Box 465-NH, Wilmington, DE 19899

OWL COLLECTORS. Subscribe to bimonthly newsletter The Owl's Nest. $10 year. $2 sample. Howards, Box 5491, Fresno, CA 93755

Correspondence

INTERNATIONAL PEN FRIENDS—70,000 members in 143 countries, ages 8-89. Also special services for the blind. International Pen Friends, Box 65, Brooklyn, NY 11229

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin 11, West Germany

PENFRIENDS-ENGLAND-USA. Make lasting friendships through correspondence. Send age, interests. Free reply Harmony, Box 89NH, Brooklyn, NY 11235

SINGLE BOOKLOVERS gets cultured persons acquainted. Nationwide. Established 1970. Write Box AE, Swarthmore, PA 19081 or call 215-566-2132

Education

FIELD EXPEDITION courses in bird identification, raptor ecology and behavior, field ornithology 3-5 weeks, credit option. 15 June-30 August in Southeast Oregon and Western Montana Write Dr. Steven G. Herman, Evergreen State College, Olympia, WA 98505

summer graduate studies

SCIENCE EDUCATION AND SOCIAL RESPONSIBILITY

College of the Atlantic
Bar Harbor, Maine
In cooperation with the
University of Maine at Orono
June 28 - July 23, 1982
For information write:
Ted Koffman, Summer Program
Box N.H., College of the Atlantic
Bar Harbor, Maine 04609
Telephone: 207-288-5015

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest handbook, $2.00 (guaranteed). Australian International, Box 19107-RP, Washington, DC 20036.

AUSTRALIA—NEW ZEALAND—THE WORLD! 50,000 Jobs! Big pay. All occupations. Transportation. Tax free. Computerizerd reports $2.00. Jobworld, Box 681-NH, Cypress, CA 90630.

AUSTRALIA . . . NEW ZEALAND want you! - Jobs! - Paid Transportation! - Most comprehensive directory available! - $2 - Moneyback guarantee! "Australia" 2208-C4 Wisconsin Ave, NW, Washington, DC 20007

NUTRITIONISTS—A New Career Field

Be a **Certified Nutritionist**
- Food Stores
- Health Care Facilities
- Schools
- Community Organizations
- Food Service Businesses
- Your Own Nutrition Counseling Practice

Home Study Program Includes
- Physics & Chemistry
- Human Physiology
- Nutrients-Food, Vitamins Minerals
- Diet Management
- Buying/Storage/Cooking
- Nutrition Counseling

Toll free call 1-800-821-5234
312 W. 8th Street
NUTRITIONISTS INSTITUTE OF AMERICA • Kansas City, Mo. 64105

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RN, Washington, DC 20036

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . . Intermountain 4Y, 3506 Birch, Cheyenne, WY 82001

TEACH HERE—TEACH ABROAD: School, College openings: USA $5.95; Abroad $5.95. Placement sources: USA $4.95; Abroad $4.95. EISF, Box 662, Newton, Massachusetts 02162

WILDLIFE PHOTOGRAPHERS wanted to join staff of rapidly expanding company in Fla. Applicants already experienced in filming wildlife for TV should send full resume to: JOHN PALING & CO., 3436 N.E. 2nd Ave., Ft. Lauderdale, Fla. 33334.

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Kenya Sampler: 4/$2.98. Free Brochure. Multinewspapers, Box DE-201, Dana Point, California 92629

Garden

WILDFLOWERS, HERBS, FERNS.

Rootstocks, bulbs, plants.
Illustrated catalogue $1,
refundable with order.
NEW ENGLAND ROOTSTOCK ASSOCIATION
Department H42, Box 76,
Cambridge, New York 12816

Gourmet Interests

EASY HOMEMADE PIZZA! Neopolitan or Sicilian. Better and cheaper than pizzeria pizza. $1.00 SASE to Box 1312, Jacksonville, OR 97530

MEAL-IN-A-MUFFIN. Very nutritious, fast, & neat . . . for backpackers, commuters. $1.00 & SASE to P.O. Box 1017, San Luis Obispo, CA 93406

MINNESOTA WILD RICE. $7.00 pound, five pound minimum. Floura Bros., Box 44C, Blackduck, MN 56630

SHERRY STYLE WINE. Send $3.50 for step by step recipe. Wine Recipes, Ltd., P.O. Box 873, Forest Hills, NY 11375

TEN PIONEER RECIPES from the hills of Pennsylvania adapted for modern kitchens. $2.50 SASE Martyjoe, Box 36, Sharon, PA 16146

TRADITIONAL SWEDISH RECIPES. Send $2.00 SASE to Ingrid, P.O. Box 74, New York, NY 10225

Government Surplus

GOVERNMENT SURPLUS! Millions of items (Including Jeeps) . . . low as 1¢ on dollar! Most complete Directory available—$2.00. Disposal, Box 19107-RN, Washington, DC 20036

JEEPS, CARS from $35!—700,000 items! Government Surplus—Most Comprehensive Directory Available Tells How, Where To Buy—Your Area—$2—Moneyback Guarantee—"Surplus Information Services," Box 3070-DC4, Santa Barbara, CA 93105

Merchandise

ALASKAN WILDLIFE AND WILDERNESS NOTECARDS. Illustrated with dramatic color photographs. Satisfaction guaranteed. 10 different cards and envelopes. $5.75 ppd Alaska Wild Images, P.O. Box 23, Trapper Creek, Alaska 99688

THE MARKET

BLUEBIRD BIRDHOUSE PLANS. For detailed plans of proven design, send $2.00 to Alexander's Birdhouses, P.O. Box 4494, Roanoke, VA 24015

GEODESIC DOME MODELS easy assembly, floor plan grids, all ¼" scale, specify diameter: 35', 39', 45'. Send $6.00 to: G.T. Ent., Inc., dept NH, PO Box D, Alpha, NJ 08865

"I LIKE IT WILD® . . ." Wilderness/wildlife posters, T-shirts, note cards. Send stamped envelope: Wilderness Dreams®, Box 4455-N, Shawnee Mission, KS 66204

NATURAL GOLD NUGGETS
Created from the Mother Lode legacy of adventure - 21-22K pure!

Each natural nugget pendant accompanied with certificate of authenticity, velvet pouch, and gift box.

Sizes 1–31 grams, $40.00 per gram. Add $4.00 shipping and insurance. Send check or money order to:

Windsor Mining Ventures
P.O. Box 2034
Salisbury, N.C. 28144
(704) 637-7381

Money back guarantee.

POSTERS! World-famous poster art! Lithographic recreations. Free brochure. Write: Posters, Box 573-N. Hicksville, NY 11802

WOLF PHOTOS, Slides, postcards. Free brochure, lists. J. Lidle, P.O. Box 112, Clifton Hts., PA 19018

Misc

Get cash grants—from Government. (Never repay.) Also, cash loans available. All ages eligible. Complete information, $2 (refundable). Surplus Funds-NH, 1629 K St., Washington, D.C. 20006

INTEGRATE THE BEST OF URBAN AND RURAL LIFESTYLES with progressive political and social values in one of five established rural communities. Nonsexist, non-racist, gentle cultures based on cooperation, equality and environmental concern. For free information ($3.00 donation appreciated) write: Federation of Egalitarian Communities, Box E NH 42, Tecumseh, MO. 65760.

Optical

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired Large stock Orders filled postpaid day received. Birding, Box 5N. Amsterdam, NY 12010

Personals

MEET SINGLES Mexico, Orient, Europe, Australia. Free information. Write: International, Box 1716-NH, Chula Vista, CA 92012

TRAVEL COMPANIONS INDIA, NEPAL, SRI LANKA September thru December. $250. monthly P.O B. 13952, Gainesville, Florida 32604

Real Estate

FREE. BIG SPRING CATALOG! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Recreation, Retirement buys! Selected best throughout the U S Over 700 offices, 43 states all across America! Yours free from the world's largest! Strout Realty, Inc., Executive Park Tower, Dept. 5390, Albany, NY 12203. Call toll free 1-800-641-4266

FREE CATALOG. Describes and pictures farms, ranches, acreages, businesses and town and country homes from coast to coast. UNITED FARM AGENCY, INC., 612-U W 47th St., Kansas City, MO 64112. Call Toll-Free· 1-800-821-2599; MO res. call Toll-Free: 1-800-892-5785

GOVERNMENT LANDS . FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00. Lands, Box 19107-RN, Washington, DC 20036

HOUSE BUYING GUIDE helps you compare houses, energy costs, and work with budgets. Send $4 to JFM Art Selections, Inc., D12, PO Box 2176, LIC, NY 11102

ABACO, BAHAMAS—3 bedroom seaside rental cottage. Ocean view with miles of white sand beach and offshore coral reefs. Secluded subtropical setting. Weekly/monthly vacation rentals (off season rates). Pingeon, 401 E. 65th St., NY, NY 10021. (212) 794-0318

FRIPP ISLAND, S.C. Luxurious ocean front condominium, 3½ miles unspoiled beach. One bedroom, tastefully furnished, modern kitchen, dining, living, sleeps four Golf, tennis, wildlife sanctuary, near historic Beaufort & Savannah. (201-545-1256)

THE MOST BEAUTIFUL WATERFRONT LOTS left in populated Florida Incredible natural beauty. Build your dream house in a real Museum of Natural History 1¼ acres $200,000. (305) 724-9290.

Resorts

ADIRONDACK LODGES on Upper Saranac Lake. Available for two weeks or a month, July through September. Everything provided for comfortable living in the quiet woods. $650-$1,700 for two weeks. Please write Bartlett Carry Club, RFD 3, Tupper Lake, NY 12986

ADIRONDACK WILDERNESS, sparkling mountain lake, informal, great tennis, food, hiking, horses; family rates. American Plan Timberlock, Box NH, Indian Lake, NY 12864

ALASKAN WILDERNESS FAMILY invites you to share their coastal wilderness. Sincere, informal hospitality in a spectacular sea and mountain panorama. The place for those desiring quiet solitude; for birders, naturalists, photographers. 30 foot tides, prolific seabird and marine life. Glaciers, nesting eagles, bears, sea otters, seals, whales, untracked beaches, forest trails Pull in crab and shrimp pots; catch salmon, trout, halibut, dig clams, gather mussels. An in-depth, educational experience. 8 guests only. $1125.00/5 days. Cozy cabins, gourmet meals. Called America's best wilderness lodge. The McBrides, China Poot Bay via Box 956NH, Homer, AK 99603, radio/phone (907) 235-8910. Write for brochure.

LITTLE ST. SIMONS ISLAND
One of Georgia's "Golden Isles"

Birding, beachcombing, riding, wildlife photography, fishing or just relaxing on a secluded 12,000 acre island with miles of unspoiled ocean beaches, forests and marshes. Over 200 species of birds. Maximum of 10-15 guests at a time. Excellent food and accommodations. Professional naturalists on the staff. **Little St. Simons Island** P O. Box 1096N, St. Simons Island, GA 31522

OLD FASHIONED, Secluded Farm on Cape Breton Island offers log cabins, excellent meals, peace to a few guests. $250/week. Write: John Gardner, Orangedale, Nova Scotia.

SUPERB BIRDING—Resident naturalist, Musky fishing, highly rated small luxury full-service lakeside resort in National Forest, heated pool, tennis, NO speed boats or waterskiing. Ross' Teal Lake Lodge, Rt7nh, Hayward, Wis. 54843 (715) 462-3631

THIS IS A SMALL AD FOR A SMALL PLACE The most isolated, and highest, private guest ranch in the Wyoming Rockies. Completely surrounded by National Forest. 50 miles from nearest town. No telephone. Fine horses. Endless trails. Numerous wily trout. Limited to 18 guests Darwin Ranch, Inc., Box 511, Jackson, WY 83001

WESTERN ADVENTURE on authentic ranch. Fun for all ages. Operating stock ranch 50 miles north of Yellowstone Park A birders paradise. Riding, fishing, pack trips. All ranch activities 63 Ranch, Box NH979, Livingston, MT 59047. Tel. 406-222-0570

Tours/Trips

ADVENTURE TRAVEL: Tanzania, Camping Safaris, Peru natural history, Himalayan Treks, Australian Adventures. Special birdwatching and natural history departures. Overseas Adventure Travel, 1430 Mass. Ave. #303N, Cambridge, MA 02138. (617) 876-0533

I SELL THE BEST THINGS
Coca-Cola
150
BEVETE

Jim Hollander

Street vendor, Rome

AFRICAN WILDLIFE SAFARIS. Kenya, Tanzania, Rwanda. Small groups guided by expert naturalists. Summer, 1982 and Winter, 1983. Special departures organized for college and university groups. Write for free catalog: Wilderness Travel, 1760-AF Solano Avenue, Berkeley, CA 94707

ALASKA NATURAL HISTORY CAMPS, North Slope and Misty Fjords. Washington wildflowers. Hawaiian Gardens Horticulture Tours. Brad's Tours, 401 E. Mercer #31D, Seattle, WA 98102

ALASKA NATURAL HISTORY TOUR, July 23 - Aug 7. Visit Glacier Bay, Mt. McKinley National Park and Katmai National Monument accompanied by expert naturalist leader. Extraordinary wildlife and scenery. Wilderness Travel, 1760-AA Soloano Avenue, Berkeley, CA 94707

ALASKAN WATER ADVENTURES. Kayaking, Rafting, Birding in Prince William Sound and Copper River Basin. Open Door, Box 1185N, Cordova, Alaska 99574 (907) 424-7466

ALL SEASONS SAILING SCHOOL. Novice and Advanced Seamanship Courses aboard 50′ ketch 'Palisander'. Summers in Chesapeake Bay, winters in French West Indies. Also Ocean Passages to Bermuda, Windward and Virgin Islands; Inland Waterway and Island-hopping cruises. $600.00/week/person. Cuttyhunk Marine Adventures, 2809 Dumbarton Ave., Washington, D.C. 20007

AVID TOURS. Take a fresh look at Canada's Atlantic Provinces with Roger Burrows, author of "A Birdwatcher's Guide to Atlantic Canada". Visit some of the largest seabird colonies in the world, seek out hard-to-find boreal birds, or just enjoy the traditions and friendliness of Canada's oldest settlements. There is even a tour to suit those who want to rough it to search for European shorebirds along Newfoundland's rugged east coast. Further details of tours and books available from Avid Services, PO Box 73, Glovertown, Newfoundland, A0G 2L0, Canada

BACKPACK AND LEARN in the River of No Return Wilderness, Idaho. Join one of our six or ten day hikes through this spectacular 2½ million acre treasure. Trips for all abilities, everything provided, and small groups. Write. Wilderness Trails, POB 9252N, Moscow, Idaho 83843. 208-882-1955

CANOE TRIPS in wilderness Nova Scotia. July-September. Small groups with licensed guides. Excellent food. Write: Granville Nickerson, RR4N, Annapolis Royal, NS BOS 1A0, Canada

COLLEGE CREDIT BACKPACKING COLORADO Mountaineering Natural History Packstocking 17-70 Yrs. 5 days $25/day. Alpenglow Educational Adventures, 139N Adams, MonteVista, CO 81144

DISCOVER BAJA! Join professional naturalists & crew for ocean going exploration of Baja's wilderness islands and lagoons. Gray whales up close, elephant seals, superb birding & lots more! Excellent photo opportunities, small groups. Color brochure. Pacific Adventures Charter Service, 2445 Morena Blvd., Suite 200H, San Diego, CA 92110

EXPLORE THE ROCKIES: Small group workshops in environmental and photographic topics. Conducted by biologists and qualified professionals in Colorado's Never Summer Wilderness Area. Packhorses, carry the gear. College credit available. Write: Scientific Educational Expeditions, 2715 Parklake Ct., Fort Collins, CO 80525

GALAPAGOS. Explore with Scripps Aquarium. Land & Sea. Professional ecologist escort. Arranged by Lindblad Tours. Nov. 17-Nov. 30, 1982. Write Scripps Aquarium, La Jolla, CA 92093

GALAPAGOS HIKING AND SAILING EXPEDITIONS. Small groups. 1982 dates: February 4, April 22, July 7, August 4. Charters: Machu Picchu options and Chili ski options. Inca Floats, 5982N Balboa, Oakland, CA 94611 (415) 339-9095

GALAPAGOS ISLANDS. Economic guided tours from $1638. Including airfare. 4, 5, 8, & 15 days Galapagos, all meals. Options, mainland Ecuador, Amazon, Cuzco/Machu Picchu. University credit available. Joseph Colley, Last, Inc., 43 Millstone Rd., Randallstown, MD 21133. 301-922-3116.

GO WILD with New York Zoological Society wildlife tours led by the scientific staff of the Bronx Zoo and the New York Aquarium

Birds of Prey . . . . May 15-22
Tour the Zoos of Great Britian . . . . June 25-July 13
The Best of Kenya with Extension to Rwanda . . . July 9-27
Alaska-The Last Frontier . . . . July 17-Aug. 2
Gorilla Stalking in Zaire with Extension to Kenya . . . . Aug. 7-22
Peru/Galapagos . . . . . July 17-Aug. 4
Zimbabwe/Botswana . . . . Sept. 7-23
Asian Wilds . . . . Nov. 26-Dec. 19

College Credit is Available

EXPLORE

New York Zoological Society
Box 108, Bronx, New York 10460
Or Call Ms. Freed—212/220-5085

GORILLAS IN RWANDA—African Photo safaris viewing gorillas in Rwanda, wildlife and birds in Kenya, Tanzania, Zambia, Botswana, and Madagascar. Brochure with 25 trips. Adventures International, Dept. NC, 4421 Albert, Oakland, CA 94619

HUBBARD
SWEET
SQUASH
25¢

Seattle market Steve Meltzer

HIKE THE SWISS ALPS. Swissair flies you to special hiking tours, led by author/mountaineer, Fred Jacobson. Zermatt, Lenk, Saas-Fee, Kandersteg, Pontresina, and Wengen. Beautiful and challenging trails. Delightful country inns. Superb cuisine. 10th summer! Write: Jacobson, Dept. L, Chappaqua Travel, 24 S. Greeley Ave., Chappaqua, NY 10514

KENYA—Very exclusive photographic safaris for up to six, choosing your own itinerary, at Packaged Tour prices with Mervyn Carnelley, Box 79, Naivasha, Kenya

MADAGASCAR/RWANDA/TANZANIA/ZAIRE: Living Fossils, Gorilla Tracking, Wildlife, Afro-Asian cultures. Forum Travel, 2437 Durant, Berkeley, CA 94704 (415) 843-8294

PERU: TREKKING THE INCA TRAIL. Hike through the heart of the ancient Inca empire to Machu Picchu. Explore colorful native markets and fascinating ruins in the Urubamba Valley (Sacred Valley of the Inca). July 30 - August 13, 1982 (15 days). Cost: $1190. Write: High Country Passage, P.O. Box 1100, Hamilton, MT 59840. (406) 363-2555.

RAFT & KAYAK IDAHO'S SALMON RIVER—exciting rapids & serene floating through majestic mountain landscapes. Brochure: SALMON RIVER OUT-FITTERS, Box 307N, Columbia, CA 95310 (209) 532-2766

ROBERT BATEMAN, GEORGE KALEF, FREEMAN PATTERSON—educational wilderness trips to Arctic-Western Canada. Ecosummer Canada Expeditions, 1666-NH Duranleau St., Vancouver, B.C. V6H 3S4, Canada.

SERENGETI: MIGRATION OF WILDEBEEST. 1982 departures. Send for details. Overseas Adventure Travel, 1430 Mass. Ave. #303N, Cambridge, MA 02138 (617) 876-0533

SITES & SCENES: LATIN AMERICA/AFRICA/EUROPE/ASIA. Largest program of uncommon nature and culture trips (including trekking and special interest tours) at unbeatable prices, for groups or individuals. Favorites: Peru (MachuPicchu, Amazon, Explorer's Inn, Titicaca, Nazca), Ecuador (Galapagos, Devil's Railroad, Otavalo), Costa Rica (Tropical Treasures), Madagascar ("Land of Living Fossils"), Kenya/Tanzania Safaris, Rwanda/Zaire (Gorilla Tracking), Greece/Turkey (Textile Arts, Archeology), Etc. Forum Travel, 2437 Durant, Berkeley, CA 94704 (415) 843-8294

SUMMER IN YELLOWSTONE. Join us in Yellowstone National Park for field seminars on wildlife, geology, plants, art, photography, history, etc. Accommodations at Park Service facility. Academic credit available. The Yellowstone Institute, P.O. Box 515, Yellowstone National Park, WY 82190

VACATION ON HORSEBACK—Washington's Beautiful Cascades—Free Brochure. Lightning D Ranch, R#1 Box 1000, Moxee, WN 98936

WILDERNESS CANOE TRAVEL. Alaska, Maine, and Canada. Completely outfitted trips with small groups. Northern Rivers, Box 326, Orono, ME 04473

RATES AND STYLE INFORMATION

$1.75 per word; 16 word ($28) minimum. *Display classified* is $150 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY to: The Market, NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024. Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—1st of the month, two months prior to cover date (the January issue closes Nov. 1). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

The 1982 NATURAL HISTORY Photographic Competition Is Open for Entries

The Grand Prize for the 1982 Natural History Photographic Competition will be an eleven-day trip to the Galápagos Islands, the volcanic archipelago that lies in the Pacific Ocean 600 miles off the coast of Ecuador. The prize, worth more than $2,500, includes airfare from New York, a stay in highland Ecuador, and a berth on the yacht *Buccaneer*. A living laboratory for the study of natural history, the Galápagos Islands are renowned for the influence they had on Charles Darwin and the development of evolutionary theory. The islands' exotic birds and reptiles—many unique to the area—are remarkably tame; our Grand Prize-winner can look forward to a rare opportunity to record wildlife at close range. Three Museum scientists will introduce the biological and geological features encountered during this American Museum of Natural History Discovery Tour.

First Prizes of $500 each will be awarded in the contest's five categories: Animals (including birds and bugs); Plants and Their Environment; The Human Family; A Sequence in Nature (up to five photographs); and Humor in Nature. Ten Honorable Mentions of $100 will be selected from all entries.

In addition, the designer and the editor of *Natural History* will choose a special $500 Cover Photograph Award for the July 1982 issue. Strong design, wide appeal, vertical format, and space for the magazine's logo will be among the points considered for this award.

The winning entries will be published in the July issue of *Natural History* and exhibited at the American Museum of Natural History. All winners will receive certificates of their awards, suitable for framing.

The 1982 *Natural History*
Photographic Competition
—Official Entry—

Name ______
Address ______
______
______
Phone ( ) ______

For office use

Logged in:
______
date initials

Returned:
______
date initials

List all photographs entered, including each item in a sequence:
number: ______ transparencies
number: ______ prints
total: ______

THE RULES

1. The competition is open to everyone except employees of the American Museum and their kin.

2. You may submit a total of up to five entries, in any combination of the categories (a sequence is considered a single entry). The photographs must have been taken by you and not have been published before.

3. The Museum acquires the right to publish, exhibit, and use for promotion the winning photographs. The Museum assumes no responsibility for entries.

4. Entries may be transparencies or prints, either color or black-and-white, up to 8 by 10 inches. Each must bear the photographer's name and address. Entries must *not* be mounted in glass.

5. Please enclose the official entry form (or a 3- by 5-inch facsimile), with your name, address, phone number, and total number of photographs submitted.

6. A self-addressed, stamped envelope must accompany your entries for them to be returned.

7. Entries must be postmarked no later than April 1, 1982.

Pack them carefully and mail them to:
Natural History Photographic Competition
11 West 77th Street
New York, New York 10024

And good luck!

Komodo Dragon

West of Timor and east of Java lie the Lesser Sunda Islands. One of the smallest of these islands is Komodo, sandwiched between Flores and Sumbawa in Lintah Strait. A 22-mile-long series of eroded volcanic plugs, Komodo Island rises several thousand feet above the sea and is covered with grass, tall gubbong palms, and pockets of jungle. Because of the island's position in Lintah Strait, tidal currents, backed by monsoon winds, rip past its shores and churn about its numerous coral reefs at a speed of some thirteen knots. These treacherous currents are probably what prevented early human settlement of the island and are certainly what prevented exploration by Europeans until the twentieth century.

In 1912, some Malay pearl divers risked the currents and anchored in a harbor on Komodo, hoping for a rich haul from the virgin oyster beds. After landing, they saw gigantic lizards wandering about the island's rocky volcanic slopes and uplands. Their story reached P.A. Ouwens, director of the Zoological Museum in Buitenzorg (now Bogor), Java, who for years had heard persistent rumors about "dragons" in the Lesser Sundas. Ouwens found the story compelling enough to send collectors to Komodo, who shot and brought back several specimens of a nine-foot-long black lizard. Ouwens described the new species and named it *Varanus komodensis*; the public called it the Komodo dragon.

In 1926, W. Douglas Burden, a trustee of the American Museum of Natural History, decided he was going to capture and bring back several live Komodo dragons and also some preserved specimens for study at the Museum. A wealthy philanthropist and an enthusiastic hunter, Burden had frequently volunteered his money and services to the Museum for collecting rare and dangerous animals for Museum habitat groups. By the time he was twenty-eight, he had stalked brown bear in Alaska; elephant, tiger, rhino, and water buffalo in the jungles of Indochina; goral, Asian roe deer, and Mongolian argali along the Sino-Mongolian frontier; and ibex, red bear, and Marco Polo sheep in the high Himalayas. He was a superb hunter who loved the thrill of the chase but felt ambivalent about killing. He wrote: "It is a desperate thing to love wild animals and yet to kill them."

The chance to launch an expedition to Komodo and bring the first dragons to the West was something Burden couldn't pass up, and he proposed the trip in a letter to Henry Fairfield Osborn, president of the Museum, who enthusiastically endorsed the idea. With his own funds, Burden put together a crew that included a Chinese cameraman from Singapore; F.J. Defosse, a taciturn, scruffy old hunter who had spent years stalking big game in the jungles of Indochina; a herpetologist named E.R. Dunn; and fifteen Malays. The Dutch colonial government provided the S.S. *Dog* for the expedition.

On June 9, 1926, after a journey of 15,000 miles, Burden and his crew sighted Komodo, and *Dog*'s captain negotiated the boat through the churning waters of Lintah Strait. They anchored in Python Bay on the lee side of the island. Burden later described the "weird island":

> The shore was a curving ribbon of sand . . . with its sharp serrated skyline, its gnarled mountains, its mellow sun-washed valleys and the giant pinnacles that bared themselves like fangs to the sky, [the island] looked as fantastic as the mountains of the moon. . . . We seemed to be entering a lost world.

Burden found Komodo overrun with deer, wild boar, and dangerous water buffalo, and everywhere he saw signs of the great lizard.

After several days exploring the island, the expedition set up camp on a 2,000-foot-plateau near a pool whose muddy shores were crisscrossed by tracks of the Komodo dragon. Not far from here Burden spied his first lizard:

> A large dark object moving in the distant grass caught my eye. . . . Sure enough it was a varanid—a giant lizard. There was something almost unbelievable about it . . . it looked enormous. . . . He swung his grim head this way and that, obviously hunting, his sharp eyes searching for anything that moved. A primeval monster in a primeval setting.

Burden wanted to photograph and film the beasts, as well as collect them, and he began setting out bait. Although they sometimes ambush boars, deer, and even buffaloes on forest trails, the dragons prefer to feed on rotting carcasses. Burden lashed dead animals to stakes driven into the ground and filmed the lizards when they came to feed. Once at the bait, the lizard clamped its jaws on the carcass, sinking its recurved, serrated teeth into the flesh. By rocking back and forth on braced legs and wrenching the carcass, the lizard would tear off great slabs of flesh, then tilt its head back and swallow them whole. Burden actually watched one lizard rip a boar in half and gulp down the hindquarters—legs, hoofs, and all.

Despite their frightful appearance, stalking and shooting the Komodo dragons proved to be easy. Burden described bagging one animal:

> About fifty yards up the sandy draw a very large lizard strode ponderously into view. This was a real dragon. He would do perfectly, I thought, for the Museum group. I started the movie camera and obtained some wonderful footage. . . . A ragged customer, black as dead lava, every aspect spoke of infinite existence. . . . Once at the bait . . . he took the whole boar in his jaws and started rocking back and forth with all his power, trying to wrench it free. It was a seesaw motion so violently performed I felt the rope might break at any moment and I would lose the animal. . . . So I picked up my rifle and shot him.

Capturing the dragons alive, however, was a little trickier. On one occasion the Malay hunters reported seeing a huge, battle-scarred lizard on the edge of a jungle thicket. Hoping to catch the dragon alive, Burden and Defosse went to the spot and began rigging a trap. They killed a fat boar for bait, and the Malays pounded thick stakes in the ground all around the animal, leaving a narrow opening. Defosse selected a nearby tree as a spring pole, and with

LET AUDUBON OPEN YOUR EYES.

To the unseen world beneath the Colorado Plateau. To the hidden implications of the second age of coal. To a world where sharks are our friends.

Subscribe to Audubon magazine today for only $16.00 per year.

NAME ______

ADDRESS ______

CITY ______

STATE ______ ZIP ______

☐ Please send me one year's subscription to Audubon magazine for $16.00. ☐ Please send me information about the benefits of joining the National Audubon Society.

I wish to pay in the following manner.
☐ PAYMENT ENCLOSED ☐ BILL ME

AUDUBON MAGAZINE IT WILL OPEN YOUR EYES

5NH2

No postage
necessary if
mailed in the
United States

BUSINESS REPLY CARD

FIRST CLASS / PERMIT NO. 3651 / NEW YORK, NEW YORK

Postage will be paid by addressee:

NATIONAL AUDUBON SOCIETY
950 THIRD AVENUE
NEW YORK, NEW YORK 10022

YOU COULD STEP ACROSS IT WITH NO IDEA OF WHAT YOU HAD MISSED.

On the surface it is simply a crack in the desert floor. Only the curious would peer into one. Very few would venture inside.

The air is cool. The spaces enlarge and a strange light surrounds you. Red, blue, yellow—eerie shapes take form against the rock.

It was water—sudden, powerful floods of water—that carved these dark, foreboding canyons beneath the Colorado Plateau.

And it was Audubon magazine that finally brought them to light.

In a world where much of what we see is only a fraction of what we really can see, Audubon magazine is that closer look.

Whether enlarging for view a seemingly ordinary feather, or breaking down the far-reaching effects of the second age of coal, Audubon will open your eyes.

With some of the lushest, most compelling photography in the world. And reporting that's earned three National Magazine Awards.

Although our days are spent in the business of living and our perceptions come only from a world we can see, humanity hasn't lost its vision.

We are still quite capable of surprise. Of wonder. Of excitement. And even awe.

To awaken ourselves to the life of this planet, to arouse, to inspect, to continuously probe—this is the purpose of Audubon magazine.

If you have never seen Audubon magazine—or if you've stepped across it and passed it by—we invite you to open just one issue. Truly, it will open your eyes.

AUDUBON MAGAZINE
IT WILL OPEN YOUR EYES
AUDUBON: 950 THIRD AVENUE, NEW YORK, N.Y. 10022

fifteen Malays pulling, the tree was bent to the ground. A noose was set at the opening of the trap, and the whole contraption was camouflaged with leaves and grass. A release string attached to the spring pole ran along the ground to a boma that hid Burden, Defosse, and the Malays.

The first visitor was a small lizard, which was soon chased away by a larger one. The second lizard went into the trap and tried to drag the boar out, but Burden held off tripping the spring pole, hoping that the old, scarred dragon would scent the bait. Not much later, the old giant crept into the clearing, sending the lizard in the trap fleeing into the jungle "as if the devil were after him." The beast was very suspicious of the trap and spent about thirty minutes making up its mind to go in.

> He looked black as ink, his bony armor was scarred and blistered. His eyes, deep set in their sockets, looked out on the world from beneath hanging brows. . . . Here at last was a real monster.

Suddenly, the huge creature charged through the noose and clamped down on the bait. Burden tugged the release:

> Immediately the dragon found himself sailing in the air. A moment later there was a terrible cracking, for, as the beast fell again, the rope tightened and under his weight the spring pole broke and bent far down so that our prize, instead of being suspended in mid-air, was on the ground, tugging at the tether which held him about the middle. Then as the natives ran out to surround him, the ugly brute began vomiting.

The Malays wisely refused to go near the raging animal, but Defosse was ready with a lasso. A strange pair they made, the old hunter and his grim antagonist—who by this time was lashing himself into a frightful rage, the foam dripping from his jaws.

After a few throws Defosse neatly dropped a lasso around the animal's neck and another around its tail. After much effort, the Malays and Defosse finally managed to tie the lizard to a pole, carry it to camp, and release it in a specially built cage. Once the dragon was free in the cage, it worked itself into another "magnificent fury" of snapping, clawing, and vomiting, and the smell was so offensive that Burden had the cage moved far downwind of the camp. When he inspected it the next day, he found that the animal had bitten and clawed its way through the thick steel mesh at the top and disappeared.

Although his prize catch had es-

Chimps, Gorillas, Orangs, and Us

The Museum, in conjunction with the L.S.B. Leakey Foundation, is presenting a symposium, *Humans and Apes: Pathways in the Search for Human Origins.* Three well-known primatologists, Jane Goodall, Dian Fossey, and Birute Galdikas, will join moderator Donald Johanson for the afternoon and evening programs. *Humans and Apes* will take place on Saturday, May 15, from 2:00 to 5:00 P.M., and from 7:00 to 9:00 P.M. in the Hunter College Assembly Hall. Goodall, Fossey, and Galdikas—all students of the late Louis Leakey—will discuss great ape behavior, and how it adds to our understanding of human evolution, with Johanson, discoverer of the "Lucy" skeleton. Ticket reservations are strongly advised. Please call the Membership Office for information on tickets and reservations.

Ellington et al.

The African-American program of the Education Department is planning a number of free concerts, films, and other programs in April.

Music Is the Word. The Brewery Puppet Troupe will present a special children's show involving "crow minstrels," who travel from town to town singing and meeting such musical stars as Billie Holiday, Duke Ellington, and Stevie Wonder. *Music Is the Word* will be presented in the Education Hall on Saturday, April 17, at 2:00 P.M.

Duke Ellington in Film. Film clips of Duke Ellington will be shown on Sunday, April 18, at 1:00 P.M. in the Education Hall. The program, narrated by Ernest Smith, includes excerpts from an Ellington appearance at the Cotton Club (1928), vintage newsreel footage of his Hit Parade gigs, and much more. Following the films, the Bobby Booker Sextet will give a performance of Ellington's popular tunes at 3:30 P.M. in the Education Hall.

Along with the live performance, a special exhibition on Stevie Wonder, Billie Holiday, and Duke Ellington by Archives in Black Culture will be on view in the Education Hall.

Early Harlem. Peggy Dickson will present a lecture and slides about the early years of Harlem (1900–1930), entitled *Stepping Out in Harlem: Sights and Sounds.* She will focus on some of the statesmen and artists who grew out of the Harlem Renaissance, including W.E.B. DuBois, Marcus Garvey, Fletcher Henderson, Bessie Smith, Louis Armstrong, and Duke Ellington. Two other lectures, *Ceremony and Spirit*, about household and ritual objects from Africa and the Americas, and *Just Ourselves*, a series of dramatic sketches about prominent black women in American history, will also be presented. These programs, which are made possible by a grant from the Avon Foundation, will take place in the People Center on Saturday and Sunday, April 17 and 18, from 1:00 to 4:30 P.M.

Bats in the Puddin'

Canada's Touring Museum for Children is coming back to the Museum to present *Bats in the Puddin'*, a program for children ages three to six years old. With puppets, costumed characters, and slides, the program tells the story of a girl and her cat who become lost in the Puddin' caves, where they meet a colony of bats and learn that these often maligned animals are quite amazing creatures. *Bats in the Puddin'* will take place on Saturday, April 24, and Sunday, April 25, at noon and 3:00 p.m. in the Education Hall. Tickets are free to members, $2 for nonmembers. Reservations, which are strongly advised, can be made by calling the Membership Office.

Short Stories, Tall Tales

For the April Members' Program, the Membership Office has invited two of America's leading storytellers, Jackie Torrence and Laura Simms, to spin some of their favorite yarns in the Museum's Auditorium. Jackie Torrence, who was raised in North Carolina, listened to her grandmother and grandfather tell tales by the fireside, including many of the Uncle Remus stories. Laura Simms specializes in tales from other cultures, and she will recount stories from Persia and South Africa, among others. *Short Stories, Tall Tales* will take place on Wednesday, April 21, at 7:30 P.M. in the Auditorium. Ticket prices are $2.50 for members, $5.00 for nonmembers. Although children are welcome to attend, the program is designed for an adult audience. Please call the Membership Office to reserve tickets.

Dance Film Festival

The Education Department, in conjunction with the Dance Films Association, will screen 3½ hours of award-winning dance films on Wednesday, April 28, at 7:00 P.M. in the Auditorium. The films were selected from the best dance films produced in 1981, as judged by experts in dance and film. Many dance forms will be presented, including modern, classical ballet, tap, ethnic, folk, and experimental dance. The program is free.

Animal Art

The Museum's displays of skeletons and mounted animals offer an excellent opportunity for artists to study animal anatomy. A small exhibit of sketches by members of the Education Department's animal drawing class are on display in the caped, Burden did capture two smaller Komodo dragons. He also shot twelve others, for a total of fourteen specimens (the Dutch colonial government had issued a permit for only fifteen). His collections were now complete, and Burden had them loaded aboard the *Dog*. In a short time, the ship sailed from Komodo, bound for New York.

The two live dragons were deposited at the Bronx Zoo, where they drew thirty thousand visitors a day until they sickened and died. On the third floor of the Museum, at the rear of the Hall of Reptiles and Amphibians, visitors can see several of the specimens Burden brought back. In characteristic fashion, one dragon has its jaws fastened on a dead boar while two others lurk nearby, their glass eyes surveying the landscape.

Douglas J. Preston

Center Gallery. The class takes artists step by step through anatomical studies, starting with skeletons and ending with animals in their natural habitats. *The Art of Animal Anatomy* is presented in conjunction with *Museum and the Creative Artist*, an exhibit in the Akeley Gallery.

Big Brains, Few Children

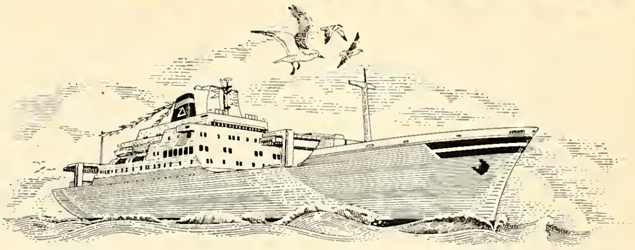
Tracing the evolution of the human brain is a key to understanding human evolution as a whole. R.D. Martin, of University College, London, is presenting the 1982 James Arthur Lecture on *Human Brain Evolution in an Ecological Context*. Martin will discuss the theory that the evolution of the large human brain was associated with small numbers of offspring and a more stable environment and resources. This free lecture will be presented in the Auditorium on Tuesday, April 27, at 6:00 P.M.

Horned Turtle

Eugene Gaffney, curator in the Department of Vertebrate Paleontology, recently discovered and reconstructed an unusual fossil turtle in Australia. This five-foot turtle had horns, a club tail, and a number of primitive characters that make it valuable for studying the evolution of turtles. The reconstruction is currently on display in an exhibit, *Horned Turtle from Down Under*, in the Roosevelt Rotunda.

For more information about programs listed in this section, call the appropriate department: Education Department (212) 873-1300; Membership Department 873-1327; Hayden Planetarium 873-1300; Discovery Tours 873-1440. Or write to the department at the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024.

54 Rms., Ocean Vu.



Delta's luxurious 20,000-ton Cruiseliners set sail for South America with just 100 pampered passengers.

Join us.

For details on our fortnightly sailings, see your Travel Agent or send us this coupon.

Ships of U.S. Registry.

Delta Line Cruises 2700 Steuart Street Tower
One Market Plaza, San Francisco, California 94106
(415) 777-8300

Please send me your colorful Cruise Brochure.

Name ____________________

Street ____________ Phone ________

City/State/Zip ____________________

My Travel Agency is ________________

NHC

Delta Line Cruises

The only 100-passenger Cruiseliners.

Telescopes from Celestron®

Will Take You To Places You've Never Been To Before
• Versatile • World's Largest Selection • Supremely Affordable

With a Celestron, the modern standard of high quality, affordable telescope performance, you can explore the craters of the Moon, the rings of Saturn, twirling galaxies and glowing nebulae. You can easily use a Celestron to photograph and view terrestrial subjects.

All Celestron telescopes have laser-tested, diffraction limited optical systems with hand-figured optics made in the U.S.A.

Celestrons® are available from 1.2- to 14-inches in diameter including the world's most popular modern telescope, the versatile Celestron 8. And, remember, most 35mm cameras easily attach to the Celestron for photography.

Free 8-page brochure or send $3.00 for 52-page full-color catalog on how to select and use a Celestron telescope/telephoto lens.

Celestron® International
2835 Columbia St., (Box 3578-NH2), Torrance, CA 90503, U.S.A. Telephone (213) 328-9560

Dealer inquiries invited.

Additional Reading

Nature Reserves (p. 6)

M. L. Shaffer's discussion of the basic concepts of reserve design, "Minimum Population Sizes for Species Conservation" (*BioScience*, vol. 31, pp. 131–34), defines the four types of risks that can lead to population extinction—demographic, environmental, and genetic stochasticity, and natural catastrophes—and describes the role of the minimum population size concept in allowing for these risks. A. J. Higgs focuses on the relative merits of a single large reserve versus several smaller reserves in "Island Biogeography and Nature Reserve Design" (*Journal of Biogeography*, vol. 8, pp. 117–24). This technical exposition also examines the usefulness of species–area relationships and advocates a thorough analysis of certain factors in each design situation—such as irreversibility, the effect of natural catastrophes, and managerial considerations. Also technical is F. S. Gilbert's "The Equilibrium Theory of Island Biogeography: Fact or Fiction" (*Journal of Biogeography*, vol. 7, pp. 209–35), which reviews the equilibrium theory throughout its development and makes reference to several major equilibrium models. After critical examination of the literature supporting the theory, Gilbert concludes that the studies are consistently flawed and therefore inconclusive and that the models are oversimplified and therefore inadequate. Consequently, he believes that reliance on the equilibrium theory in the design of reserves is premature.

Low Riders (p. 28)

"Low and Slow, Mean and Clean," by C. Trillin and E. Koren (in "Our Far-Flung Correspondents," *The New Yorker*, July 10, 1978, pp. 70–74), is an enjoyable and insightful introduction to the phenomenon and argot of low riding in East Los Angeles. Trillin describes car clubs, happenings, *cholos*, pachucos, car hopping, juiced-up cars, and the low rider's life style; Koren's cartoons illustrate "The Cholo Look," "A Car-Hopping Contest," "Cruising," and "A Car Clubber in a Bad Ride." C. Steinfort, who views low riding as an activity primarily of Mexican youth, now becoming more popular, also describes the mechanics of low riding in detail in "Lowriders: The World of Cruising, Hydraulic Suspensions, and Throwing Scrapes" (*Road and Track*, May 1980, pp. 146–49). T. Cook's short article "The Imperials" (*Hot Rod*, April 1974, pp. 70–73), about a car club in the Los Angeles area, features color photographs of low rider cars. A good source of articles on low riding is *Low Rider*, a monthly magazine published in San Jose. It features articles on the low riding life style and includes columns such as "Pasados," which highlights past styles, and "¿Qué Onda?" a family-oriented reader's section. Subscriptions are $15 a year; single copies cost $2. *Low Rider* will soon begin to publish *Technical Low Rider*, designed for the serious craftsman. For information about this and other publications, write to *Low Rider* at 763 Mabury Road, Suite 17, San Jose, California 95133. C. McWilliams's chronicle of Mexican migration into the Southwest, *North from Mexico* (New York: Greenwood Press, 1968), portrays the Mexican-American community in East Los Angeles during the 1930s and 1940s—the race riots, pachucos, and zoot suiters. *The Labyrinth of Solitude*, a collection of well-versed, self-analyzing essays by O. Paz, translated by L. Kemp (New York: Grove Press, 1961), explores life, thought, and culture in Mexico. In one chapter, Paz delves into the psychology and philosophy of pachucos and zoot suiters. *Anthropology and the Arts*, a textbook with readings in cross-cultural aesthetics by C. M. Otten (New York: Natural History Press, 1970), contains J. L. Fischer's "Art Styles as Cultural Cognitive Maps" (pp. 141–61) and R. Sieber's "The Arts and Their Changing Social Function" (pp. 203–11). Fischer uses statistical techniques to test several hypotheses concerning the relationship between art styles and social conditions; Sieber suggests that art is inextricably linked to the values of a culture and reflects that culture's search for order.

Mimicry (p. 42)

W. Wickler's *Mimicry in Plants and Animals*, translated by R. D. Martin (New York: McGraw-Hill Book Co., 1974, paperback), is a clearly written, step-by-step introduction to mimicry. Wickler, a leading authority on the subject, discusses Batesian and Müllerian mimicry, polymorphism in mimetic butterflies, mimicry and Darwinism, and aggressive mimicry, and establishes the criteria for a true mimicry system. Showing that mimicry is much more widespread than is sometimes assumed, Wickler describes the phenomenon not only in moths and butterflies but also in ants, beetles, anglerfish, and other creatures. J. R. G. Turner's "A Tale of Two Butterflies" (*Natural History*, February 1975, pp. 28–36), concentrates on mimicry in heliconiids, specifically, *Heliconius erato* and *H. melpomene*, and sheds light on how these butterflies benefit from their colorful advertising. C. Papageorgis attempts to explain why there are so many different wing-coloration complexes in one location in "Mimicry in Neotropical Butterflies" (*American Scientist*, vol. 63, pp. 522–32). Based on her investigations of mimicry rings in three Peruvian rain forest areas, she postulates that the changing background of lighting conditions on foliage requires changes in warning patterns, resulting in the divergence of closely related distasteful or mimetic species. In "Ecological Chemistry" (*Scientific American*, February 1969, pp. 22–29), L. P. Brower explores how certain insects, after feeding on plants that are poisonous to vertebrates, become poisonous to bird predators.

Sabertooth Cats (p. 50)

In "The Function of Sabre-like Canines in Carnivorous Mammals" (*American Museum of Natural History Novitates*, no. 1130, 1941), G. G. Simpson proposes that sabertooth specialization has arisen at least three times among carnivorous mammals; that mammalian saber teeth were perfectly adapted for stabbing but ill-adapted for slicing and were used for making short, stabbing slices or gashes; and that this primary adaptation of the canines and the general bodily structure is more consistent with predaceous habits than with carrion eating. B. Bohlin, on the other hand, insists that sabertooth cats, although occasionally predators, were more likely to be carrion feeders. In his "Food Habits of the Machaerodonts, with Special Regard to *Smilodon*" (*Bulletin of the Geological Institution of the University of Upsala*, vol. 28, pp. 156–74), also published in 1941, Bohlin points to evidence that the sabertooth's musculature was less adapted for attacking than for scavenging and that the tusks were more effective tools for slicing meat off dead animals than for stabbing live ones. He reasserts his position in "The Saber-Toothed Tigers Once More" (*Bulletin of the Geological Institution of the University of Upsala*, vol. 32, pp. 11–20), in which he rejects the contention that the sabertooth's use of its tusks was similar to a snake's use of its fangs, and addresses problems concerning the mechanics of stabbing. Stabs, he argues, could not have been well aimed because of the length of the teeth, which would have forced the animal's line of vision away from its prey; in addition, the fragile teeth would be prone to breaking during a predatory struggle. W. J. Gonyea, in "Behavioral Implications of Saber-toothed Felid Morphology" (*Paleobiology*, vol. 2, pp. 332–42), maintains that saber-toothed cats were equipped with claws, much like those of present-day felids, that were used to stabilize the prey. Gonyea uses analysis of limb proportions to further support the argument that sabertooths were predators. In "Functional Morphology and the Evolution of Cats" (*Transactions of the Nebraska Academy of Sciences*, vol. 8, pp. 141–54), L. D. Martin, while pointing out that definitive classification is not possible with our current knowledge of cats, favors a phylogeny for the Feloidea that accepts a basic dichotomy between the Nimravidae and the Felidae but still regards them as "sister groups."

Rita Campon

If you enjoy our whiskey, drop us a line. We'd like to hear from you

SOME OF AMERICA'S happiest cows live just down the road from Jack Daniel's Distillery.

We distill our whiskey from a mash of America's choicest grain. Then, after distilling, we sell what's left over to neighboring farmers. And they use it in liquid form to fatten up their cows. Thanks to our choice grain, we've got some highly contented cattle here in Moore County. And, we believe, some highly contented customers most everyplace else.

CHARCOAL
MELLOWED
DROP
BY DROP

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery
Lem Motlow, Prop., Inc., Route 1, Lynchburg (Pop. 361), Tennessee 37352
Placed in the National Register of Historic Places by the United States Government.

The World 'n General

GENERAL TOURS
takes you to
RUSSIA
For Under
$100/DAY!
including air fare
11 QUALITY TOURS
10-22 days

NOW YOU CAN SEE FOR YOURSELF!

- Finnair wide-body jets
- first class & deluxe hotels
- three meals a day
- full sightseeing
- all transportation in USSR
- theater performances
- American tour manager
- HAPPY TRAVEL gift
- many extras
- PLUS early booking PRICE GUARANTEE!

*per person double occupancy from NY

MEMBER ASTA American Society of Travel Agents USTOA MEMBER Pacific Area Travel Association

Member of the First Family of Travel

What A Way To Go!

GENERAL TOURS, INC.
711 THIRD AVE.
NY, NY 10017
212-687-7400 NH482
YES! I WANT TO SEE FOR MYSELF!
Please send my free copy of:
_____ THE COMPLETE RUSSIA BOOK
name ____________
address ____________
__________ zip ______
my travel agent ____________

Southern Comfort

New Zealand's Maoris traditionally steam food in heat-retaining pits

by Raymond Sokolov

Looking out over Whakarewarewa, you might think the whole village was on fire. Smoke, or what appears to be smoke, puffs like fleece in white bales among the trees and rooftops of this Maori town in the North Island of New Zealand. But the "smoke" is really steam, sulfurous vapor escaping from the earth. This geothermal exhalation produces dramatic geysers. It makes mud bubble and pop and plop. Properly tapped and gauged and valved into a modern system of pipes, it can heat a hotel and provide hot water. It can also cook a meal.

Today's Maoris, at Whaka (as the village is usually referred to) or other places in the Rotorua region of geothermal activity, will set a pot of food down in a hot pit to steam while they go about the day's business. Manufactured, flameproof pots are only one, perhaps trivial sign of Maori assimilation into postcolonial New Zealand life. They also speak English as a first language, intermarry freely with New Zealanders of European extraction, and have probably held their own—politically and economically—as well if not better than any other once-colonized minority. The Maori language is undergoing a revival. Maori dictionaries are in every bookstore. Maori words pervade not only place names but every aspect of New Zealand life. Most vividly, the outsider encounters the Maori heritage at a traditional hangi feast.

Before all else, a hangi is a meal cooked without pots. The original Maori settlers of New Zealand brought this Polynesian custom with them when they came across the Pacific in large canoes roughly 1,000 years ago. They were the southernmost wave of Polynesian migration. *Maori* originally meant "normal" or "ordinary" in Polynesian. But once they had established themselves in the temperate climate of New Zealand, Maoris adapted to it, preserving what they could of their previous mode of existence and abandoning the rest.

Because many of the crops that flourished on warmer Pacific islands would not grow well, even in the subtropical northernmost parts of North Island, Maoris did not produce such typical Polynesian crops as banana, breadfruit, and coconut. They did manage to introduce the kumara, or sweet potato (*Ipomoea batatas*). They gathered shellfish and netted the delicious minnows now called whitebait. They learned to process starch from the root of the bracken fern (*Pteridium esculentum*) and to detoxify certain wild plants such as the tutu, whose solid parts have felled farm animals and even a circus elephant. The purple juice, carefully strained, is safe. But, as the encyclopedically informed New Zealand anthropologist Helen M. Leach has written, "the Maori style of cooking was unmistakably Polynesian." She quotes the early explorer Joseph Banks, who observed Maori life around Mercury Bay in North Island and wrote in 1769:

> A little before Sunset we went home with the Indians to see them eat their Supper, it consisted of Fish, Shellfish, Lobsters & Birds, these were dress'd either by broiling them upon a skewer which was stuck into the ground leaning over the fire, or in Ovens as we call'd them at Otahite which were holes in the ground fill'd with Provision & hot stones, & covered over with leaves & Earth. . . .

The hangi feast with its earth ovens, which Banks and virtually all subsequent visitors to New Zealand have seen, is a direct descendant of the Polynesian luau and a cousin of the bounia of New Caledonia. To the North American eye, the hangi is almost a ringer for our New England clambake. Numerous other cultures around the world have doubtless hit upon the same scheme of steaming moist foods in a heat-retaining pit warmed evenly by rocks previously heated directly in the flames of a wood fire.

As Leach points out, the hangi method permits the convenient cooking of large cuts of meat and starchy foods that could not be prepared by broiling over a flame. We might choose to boil the same foods in a pot, but Polynesians did not manufacture flameproof pots. In her paper submitted to the 1981 Oxford

Symposium on National and Regional Styles of Cookery, Leach argued that pots originated in cultures that needed them to boil grain. The ancestors of the Polynesians, the Proto-Austronesians, seem to have possessed pottery as early as 4000 B.C. and they also appear to have cultivated rice. But when they began migrating to the islands beyond New Guinea after 3000 B.C., rice growing was abandoned and the driving force behind the making of cooking pots began to run down, "like the spring of a clock."

Nevertheless, even after Europeans brought pots and grain to them, the alert and receptive Maoris continued to cook food in earth ovens. Indeed, the hangi is a universal part of New Zealand life today. Cookbooks contain elaborate recipes that specify what sorts of rocks will not shatter in the fire and what sorts of material work best for wrapping the food and trapping the steam in the pit. Furthermore, during two centuries of cultural contact and intermixing, the menu of the hangi has expanded to include many foods not available in New Zealand until after European penetration.

At the hangi I attended on the grounds of the government-owned hotel at the edge of Whaka, we were served lamb and ham and wild boar. Before the days of European colonization, none of these animals existed in New Zealand. In fact, there were no land-based mammals except for a rat and a bat. Europeans introduced all the usual barnyard animals, as well as a full array of furred game animals from elk to chamois. Maori hunters had had to content themselves with the flesh of the various large, flightless birds, such as the gigantic, now-extinct moa, that filled the ecological niches occupied in other places by mammals.

At our meal, there were also many foods of pure Maori origin: indigenous mussels, eel, and kumara. But for dessert, out of the pit came that most British of desserts, that standby of Mrs. Beeton's kitchen, the steamed pudding.

Our hangi, cooked in natural geother-

UNUSUAL.

That's the ideal description of the regal island country of Sri Lanka, once known as Ceylon. It's a fabulous spectacle. Whether you're looking at our ancient cities, wondrous wildlife or miles of beaches. The ultimate is our festival of the August moon. Located in the Jasmine-scented, mountain city of Kandy, you will feast your eyes on a thousand whirling dancers, a hundred costumed elephants, and more drummers than you've ever seen. The torchlight acrobatics of this 2,000 year old Perahera will, in just a few days, leave you with a lifetime of memories.

We have an unusual variety of tours – 75 in all – ranging from 3 to 21 days. The prices? Unusually low! Accomodations begin at $5. Deluxe sells for $45.

Sri Lanka is a most unusual warm weather vacation or convention spot. Only one hour from India, three hours from Katmandu, Bangkok and Singapore. Write for a color folder and tour digest that includes special airfare.

sri Lanka
Pearl of the Indian Ocean

Ceylon Tourist Board/Dept NH24
609 Fifth Avenue, New York, N.Y. 10017

Name ____________________

Address ____________________

City/State/Zip ____________________

To be sure!

The exceptional *Argonaut* sails upstream on the Seine through Normandy. Built as the world's largest private yacht, she carries a crew and staff almost as numerous as her passengers. Their unfailingly cheerful service and a warm atmosphere of relaxed informality have endeared her voyages to hundreds who return each year to enjoy a manner of travel which cannot be duplicated.

***Argonaut* voyages continue the second century of special Raymond & Whitcomb travel in 1982**

Great Waterways of Western Europe

May 30-June 13 • July 18-August 2 • September 3-15

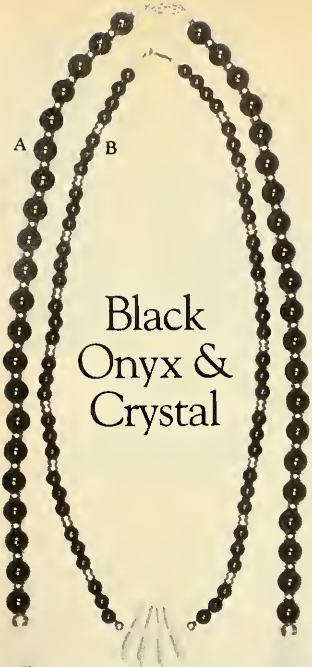
Wend through Normandy, Brittany and the Aquitaine of France on the scenic Seine, Loire and Gironde rivers. Cruise in the bays of Brest and Biscay. Call at northern Spain and Portugal. Step ashore in your preferred season to visit famed chateaux and vineyards, castles and gardens, small fishing ports and tranquil villages. Each day with congenial company and expert guidance promises good times, fresh insights, and special arrangements. $3450 to $3985 per person, double, New York to New York.

For reservations and information, call, write or visit

R& W

RAYMOND & WHITCOMB CO.
400 Madison Avenue, New York, N.Y. 10017
(212) 759-3960
"First in Travel Since 1879"

MTS Argonaut, registered in Greece



Black
Onyx &
Crystal

A. Black onyx necklace, frosted crystal beads, gold-filled rondels, 32″, $195.00.

B. Black onyx necklace with crystal fan pendant, gold filled rondels, 16″, $95.00.

Members are entitled to a 10% discount.
Please add $2 shipping and handling for each item ordered.
Add N.Y. sales tax where applicable.

Detach here

Museum Shop
American Museum
of Natural History
Central Park West
at 79th Street
N.Y., N.Y. 10024

Please send me:

____ 32″ Necklace(s)

____ 16″ Necklace(s)

I enclose a check payable to the American Museum of Natural History for $________.

Charge to ☐ Visa ☐ MasterCharge

Account # Exp. date

Signature (if using credit card)

Name

Address

City State Zip

mal steam, was a special form (ngawha or "steamed" hangi) of what has become a true national dish, not an ethnic curiosity limited to tourist hotels and militant Maori ethnocentrists. Helen Leach, for example, will do a hangi when she entertains large groups of people. It is an efficient form of cookery for crowds even when pots are available.

I am tempted to say, however, that the hangi, along with much else in New Zealand cookery, survives because it is part of the long since unified Maori-British cultural web. Both groups have taken from each other's skills and invented a culinary style quite different from what either had in the beginning. For the visitor who looks beyond lamb on menus, there are extraordinarily pungent oysters from South Island, chowders from the tuatua clam, the mild and fleshy blue cod, raw fish prepared in various Polynesian styles, and New Zealand's own fancy dessert, the Pavlova. This is a meringue named after the great ballerina and usually served filled with strawberries or the Chinese gooseberry, which is marketed across the world as the kiwi fruit. (The kiwi itself is now a protected bird, whose furry dark feathers and long, narrow, nostriled beak can be viewed in dark kiwi houses in zoos and parks.)

The truly adventurous diner, out for an extreme taste of New Zealand fare, will not hesitate to buy muttonbird at a butcher shop. Called titi by Maoris, sooty shearwater by birders, and *Puffinus griseus* by ornithologists, these seabirds are sold preserved in salt, just as the Maoris treated them before the arrival of Captain Cook. In those days, they were stored in an ornamentally carved, raised hut. Maoris are still the only people who hunt them. The law reserves to them the right to capture the flightless muttonbird chicks in their burrows on Steward Island to the south of South Island. But anyone can buy these fatty, pigeon-sized birds. Muttonbird is humble, rough fare. Recipes recommend changing the water three or four times when you boil them, to get rid of the fat. For a fancy effect, run the birds under the broiler and serve with white sauce, oysters, green salad, and French fried potatoes. Only in New Zealand.

Raymond Sokolov's new book, Fading Feast *(Farrar, Straus and Giroux), is a collection of food columns that first appeared in* Natural History.

Recipes adapted from *A Taste of New Zealand in Food and Pictures,* by Nina and Jim Munro. A.H. and A.W. Reed, 65–67 Taranaki St., Wellington, N.Z.

Maori Bread

Leaven:
5 tablespoons flour
4 tablespoons sugar

1. Mix together 3 tablespoons flour and 2 tablespoons sugar with 1¼ cups warm water to make a paste. Seal in an airtight container and let stand in a warm place for 48 hours, until the mixture has fermented.
2. Add remaining flour and sugar along with 2½ cups lukewarm water. Seal and let stand for another 48 hours.

Bread:
7 cups flour
4 tablespoons sugar
2½ cups leaven mixture

1. Mix all ingredients well and leave to prove for 8 hours in a covered bowl.
2. Knead thoroughly. Add more flour if necessary to make a firm dough.
3. Form into loaves and set in greased loaf tins.
4. Let rise for 1½ hours in tins. Preheat oven to 450 degrees.
5. Bake for 45–50 minutes.

Yield: 2 loaves

Pavlova Cake

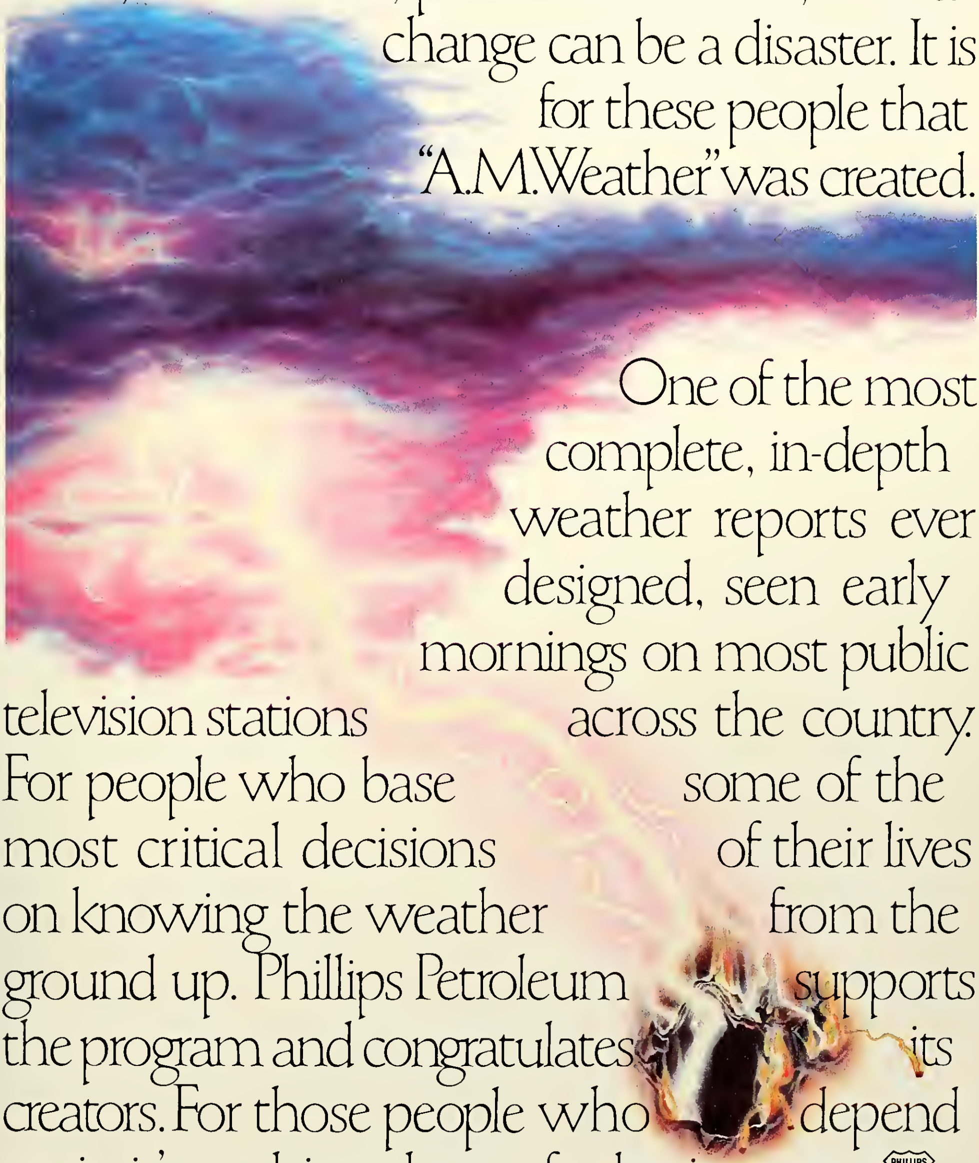
3 egg whites
Salt
¾ cup sugar
1 teaspoon vinegar
1 teaspoon vanilla
1 teaspoon cornstarch

1. Preheat oven to 275 degrees.
2. Beat the egg whites with the salt until they form soft peaks. Then beat in sugar a tablespoon at a time and beat until stiff. Finally, add remaining ingredients by folding in gently.
3. Grease and lightly flour a baking sheet. Using a 7-inch diameter plate as your guide, mark a 7-inch circle on the sheet with a knife point.
4. Spread the meringue mixture from step 1 on the outlined circle. Pile the perimeter slightly higher than the center.
5. Bake until dry outside. Turn over and continue baking until dry, about 1½ hours. Let cool in oven.
6. Decorate with whipped cream and fill with fruit, especially sliced kiwi fruit or strawberries.

Yield: 6 servings

How to keep calm before the storm.

For most of us, the weather is a nuisance. For some, like farmers, pilots and builders, a small change can be a disaster. It is for these people that "A.M.Weather" was created.



One of the most complete, in-depth weather reports ever designed, seen early mornings on most public television stations across the country. For people who base some of the most critical decisions of their lives on knowing the weather from the ground up. Phillips Petroleum supports the program and congratulates its creators. For those people who depend on it, it's nothing short of a brainstorm. PHILLIPS 66

For more information, write: A.M. Weather, Maryland Center for Public Broadcasting, Owings Mills, MD 21117

THE TASTE BEYOND 12-YEAR-OLD SCOTCH

The GLENLIVET
AGED 12 YEARS
AGED 12 YEARS
BOTTLED IN SCOTLAND
The GLENLIVET
12 YEARS OLD
Unblended all malt Scotch Whisky
Distilled and Bottled in Scotland
GEORGE & J. G. SMITH LIMITED
THE GLENLIVET DISTILLERY · GLENLIVET SCOTLAND
U.S. IMPORTERS
THE GLENLIVET DISTILLING COMPANY.
NEW YORK, N.Y.
750 ML. (25.4 FL. OZ.) ·86 PROOF
The GLENLIVET
ESTABLISHED 1824
12 YEARS OLD THE GLENLIVET SCOTCH WHISKY

Discover more.

Let your mature taste lead you from the finest premium Scotch on up to the most expensive 12-year-old Scotch in the world. The Glenlivet. The ultimate in Scotch.

Most premium Scotch is blended and depends on several whiskies for taste and smoothness.

Yet the unblended character of The Glenlivet is noble enough to stand alone. In this distinctive Scotch whisky you'll experience an exceptional smoothness and full-bodied richness, unmatched in all other premium Scotch.

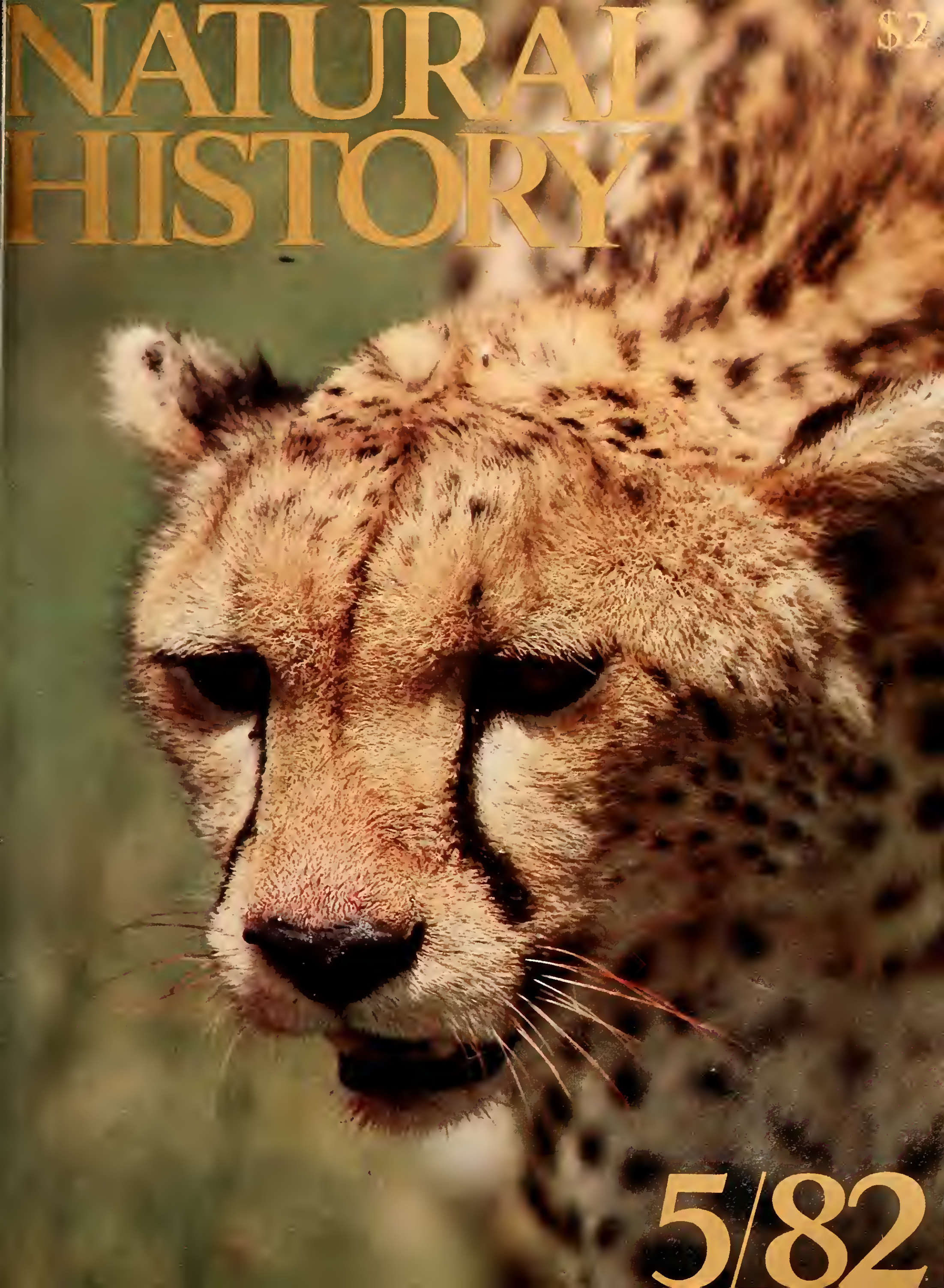
Try the taste beyond premium Scotch.

The Glenlivet
Unchanged since 1824.

NATURAL HISTORY

$2

5/82



Waterford® Won't Spill The Beans.

The reigning passion. Jellybeans under glass.
Legendary glass by Waterford. Give it to the executive
you adore. Indulge him. Or her.

photos: Pesin

NATURAL
HISTORY Vol. 91, No. 5, May 1982
American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director

Alan Ternes, Editor
Judith Friedman, Managing Editor
Thomas Page, Designer
Board of Editors: Carol Breslin, Sally Lindsay, Frederick Hartmann, Vittorio Maestro, Rebecca B. Finnell
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
E. Kay Danzig, Art Asst.
Kay Zakariasen, Picture Editor
Douglas J. Preston, Publications Editor
Annie R.C. Finch, Editorial Asst.
Lillian Berger
Editorial Advisers: Malcolm Arth, James W. Atz, Niles Eldredge, Kenneth L. Franklin, E.Craig Morris, Norman Newell, Thomas D. Nicholson, Martin Prinz, Gerard Piel, Nina Root

David D. Ryus, Publisher
L. Thomas Kelly, Associate Publisher
Bradford D. Smith, Business Manager
Frederick E. Grossman, Production Mgr.
Debra Buck McCord, Asst. Production Mgr.
Ernestine Weindorf, Administrative Asst.
Elaine M. Callender, Advtg. Production Mgr.

Cary Castle, Circulation Manager
Jeff Pieper, Assoc. Circulation Mgr.
Ramôn E. Alvarez, Asst. Circulation Mgr.
Frank Stevens, Circulation Asst.

NATURAL HISTORY *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Subscriptions: $15.00 a year. In Canada and all other countries: $20.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.* *Copyright © 1982 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of* Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.* Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225
Subscription Orders (800) 247-5470
(800) 532-1272 (in Iowa)

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

2 **Authors**

6 **This View of Life** *Stephen Jay Gould*
Hutton's Purposeful View

14 **Mount St. Helens Revisited** *James A. MacMahon*
Burrowing gophers mix ash with old soil and help other living things return to the mountain ecosystem.

27 **Books in Review** *Stanley A. Freed*
A Preference for Sons

32 **Jewelweed's Sexual Skills** *Donald M. Waller*
Why does this common flower maintain two reproduction methods?

40 **Weavers of Wood** *Peter M. Knudtson*
A few Haida women keep the art of fine basketry alive.

50 **Life on the Cheetah Circuit** *David A. Burney*
These elegant cats often survive better just outside game reserves, away from other carnivores.

60 **Fallow Field Guide to Birds** *Wesley E. Lanyon*
As abandoned fields grow into woodlands, they harbor an orderly and predictable parade of birds.

70 **Invasion of the Medfly** *William H. Jordan, Jr.*
Entomologists are probing for weak points in this insect's biological defenses.

80 **Sky Reporter** *Stephen P. Maran*
Where Do Comets Come From?

84 **Celestial Events** *Thomas D. Nicholson*

86 **Additional Reading**

88 **At the American Museum**
Life and Death of the Mark Twain

95 **A Matter of Taste** *Raymond Sokolov*
Respect Your Elders

Cover: *Some cheetahs, extremely shy of humans, are hindered in hunting because of tourists; others have adapted to hordes of onlookers. Photograph by George and Lory Frame. Story on page 50.*

From 1978 to 1979, **David A. Burney** and his wife, Lida, lived in tents in the Masai Mara National Reserve in southwestern Kenya and followed cheetahs almost daily. They recorded aspects of the animals' behavior and ecology, and the human disturbances they encountered. The project had its origins when Burney was working as a regional naturalist with the North Carolina Division of Parks and Recreation. In that position he was often called upon to devise means of protecting endangered species within the state's parks. He writes that he often asked himself, What happens to rare animals when heavily visited parks are their only refuge in the wild? Burney went on to pursue graduate studies at the University of Nairobi, and it was while there that it occurred to him that the case of the cheetah offered an opportunity to explore this question.

Lamont Curator of Birds at the American Museum, **Wesley E. Lanyon** has been with the Museum's Department of Ornithology since 1957. He was resident director of the Kalbfleisch Field Research Station on Long Island from 1958 until the station was sold by the Museum in 1980. While doing research at the station, Lanyon investigated the behavioral ecology of the birds breeding there. His main research, however, has been avian taxonomy, combining field and museum approaches and comparing closely related populations of birds. This work has taken him much farther afield than Long Island, including sixteen expeditions to South America.

Peter Knudtson began collecting information about Haida Indian basketry in the spring of 1981, while working as a researcher and writer for a National Endowment of the Arts educational videotape project. The completed videotape documents this traditional art through the work of two Haida women. Knudtson has published research on the Wintun Indians of northern California, including a May 1975 article in *Natural History*, "Flora, Shaman of the Wintun." Recipient of a master's degree in biology for research on harbor seals, Knudtson until recently taught science and social studies at a high school in Ketchikan, where many of his students were native Alaskans. He now lives in Vancouver, British Columbia, and is a full-time science writer.

While a graduate student at Princeton University, **Donald M. Waller** became "fascinated by the evolutionary enigma of sex in biology." Convinced that "plants were both more interesting and more cooperative than animals," he was especially intrigued by plants that simultaneously employed two or more means of reproduction. After consulting a survey of plant breeding systems and carrying out a season of fieldwork on several species, he narrowed his work to jewelweed. Currently an assistant professor at the University of Wisconsin at Madison, Waller is also trying to evaluate how smooth sumac, a small tree that spreads clonally, allocates its resources to the competing demands of stem growth, sexual reproduction, and clonal spread.

Living well is the best revenge.
B and B. A blend of Benedictine and fine Cognac.

© 1980 JULIUS WILE SONS & CO. IMPORTED FROM FRANCE 80 PROOF

Build your own private library for less than $20 a month!

Each volume bound in genuine leather and fine fabrics . . . the leather embellished with 22 karat gold.

Imagine being able to glance up at your bookshelf, and see there your own private library. With its proud expanse of leather spines, richly ornamented in gold, bearing the titles of the greatest books ever written.

Here, clearly, would be something of permanence in a changing and uncertain world. Something to treasure now . . . and to pass along to future generations in years to come.

A treasure, indeed, you might think—but surely an expensive luxury. *Far from it.*

For this is The Heirloom Library of the World's Greatest Books. Fifty enduring works of genius, selected by a distinguished board of advisers. In the handsome Collector's Edition, crafted for posterity in bindings of leather and fine fabrics. Ornamented with exclusive designs, the spines embellished with 22 karat gold.

Beautiful books, at a guaranteed low price—yet you make no long-term commitment

The Collector's Edition of the Heirloom Library will be issued at the convenient rate of one great book per month, for just $19.50 a volume—a price *guaranteed* for the duration of your subscription. However, *you* need make no long-term commitment. You may cancel your subscription at any time, on 30 days' written notice.

The rare pleasures of owning this personal library

As a subscriber, you would enjoy, whenever you wish, the rich pleasure of taking one of these books from your shelf—with its fragrance of leather, its satisfying weight in your hands. Then savor a moment of anticipation as you open the volume, to see your own inscribed bookplate on the decorated endpapers. And leaf through the pages admiring the burnished edges . . . the smooth, opaque paper . . . the crisp, legible type . . . the wonderfully evocative illustrations.

Above all, you would be able to enter at will . . . as one embarking on a voyage of discovery . . . the world of Hemingway or Melville, Shakespeare or Dante, Dickens or Mark Twain. The greatest books ever written, in bindings worthy of the incomparable works they contain.

Mail your order by May 31st

By the time your library is complete, even ordinary books may be selling for more than $19.50. For the costs of materials, of printing and binding, are rising almost daily. And thus it may *never again* be possible to offer subscriptions to the Collector's Edition of the Heirloom Library at this guaranteed low price. *So, to be sure of acquiring this remarkable private library for no more than $19.50 a volume, please mail the subscription form at right by May 31, 1982.*

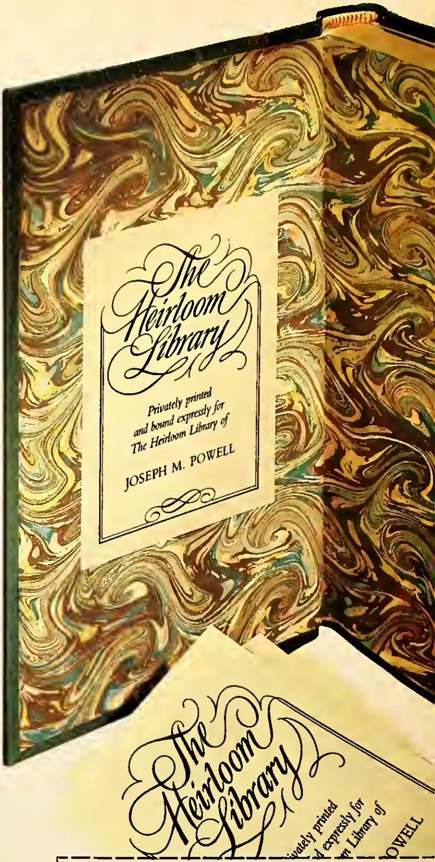
DIVINE COMEDY
DANTE ALIGHIERI

*In a time-honored collecting tradition . . .
the greatest books of the greatest writers of
all time. Bound in genuine leather and fine fabrics.
The leather embellished with 22 karat gold.*

© 1982 FM

THE HEIRLOOM LIBRARY OF THE WORLD'S GREATEST BOOKS®· Collector's Edition

WUTHERING HEIGHTS
EMILY BRONTË
A FAREWELL TO ARMS
ERNEST HEMINGWAY
THE ADVENTURES OF HUCKLEBERRY FINN
MARK TWAIN
GREAT EXPECTATIONS
CHARLES DICKENS
DON QUIXOTE DE LA MANCHA
CERVANTES
MOBY DICK
HERMAN MELVILLE
THOMAS MANN
WILLIAM SHAKESPEARE
PARADISE LOST


The Heirloom Library
Privately printed and bound expressly for The Heirloom Library of
JOSEPH M. POWELL
The Heirloom Library

- *Fifty beautiful volumes to enjoy and display in your home*
- *Issued monthly at a price not much higher than you pay for an ordinary book – just $19.50 a volume*
- *Price guaranteed for the duration of your subscription*
- *To be sure of acquiring your library at this low price, your subscription form should be postmarked by May 31, 1982*

SUBSCRIPTION APPLICATION

THE HEIRLOOM LIBRARY OF THE WORLD'S GREATEST BOOKS

Please mail by May 31, 1982.

The Franklin Library
Franklin Center, Pennsylvania 19091

Please enter my subscription to the Collector's Edition of The Heirloom Library of the World's Greatest Books: 50 volumes, to be bound in genuine leather and fine fabrics, the leather accented with 22 karat gold. I will be sent one book per month, at the price of $19.50*, guaranteed for the entire series. However, I may cancel my subscription at any time upon 30 days' written notice.

I need pay nothing now. I will be billed for each volume in advance of its shipment.

**Plus my state sales tax, and $2.50 per book for postage, shipping and handling, subject only to postage increases.*

Signature ____________________
ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE.

Mr.
Mrs.
Ms. ____________________
PLEASE PRINT CLEARLY

Address ____________________

City ____________________

State, Zip ____________________

Hutton's Purposeful View

Despite . . . or perhaps because of . . . his antiquated logic, the father of geology expanded the frontiers of science

by Stephen Jay Gould

In his tribute to Lucretius, Virgil wrote: "Happy is he who could learn the causes of things" (*Felix qui potuit rerum cognoscere causas*). A noble and uncomplicated sentiment to be sure, but an even more illustrious predecessor had shown that causality is no simple matter. Aristotle, in the *Posterior Analytics* of the *Organon*, stated: "We only think that we have knowledge of a thing when we know its cause." He then proceeded to give a complex analysis of the concept of causality itself.

Each event, Aristotle argued, has four distinct kinds of causes. Consider the so-called parable of the house, the standard example, probably in continual use for more than two thousand years, for illustrating Aristotle's schema. What is the cause of my house? What are the *sine quibus non*, the various factors whose absence would lead to no house at all or to a house of markedly different design?

First, Aristotle argues, we must have the straw, sticks, or bricks—the *material* cause. It obviously matters, as the three little pigs discovered, what material you choose. Next, someone must do the actual work, thatch the roof or lay the bricks—the effector, or *efficient* cause. The blueprint that the mason follows doesn't do anything actively, and it is not building material. But it is a cause of sorts, since different blueprints yield different houses and no plan at all leaves you with a pile of bricks. These preconceived marching orders are *formal* causes in Aristotle's lexicon. Finally, if the house served no purpose as an abode for its inhabitants, no one would bother to build it. Purposes are *final* causes.

We do not follow Aristotle's analysis in our linguistic habits today; our entire notion of "cause" is now pretty much restricted to Aristotle's efficient causes. We do not deny the material and formal aspects, but we no longer call them causes. When I identify the motion of my pool cue as *the* cause of a ball's errant trajectory (though only an efficient cause to Aristotle), I do not regard the composition of the ball or the blueprint of the table as irrelevant, but I no longer call them causes.

The elimination of purpose, or final cause, tells a more important story and represents a major change in style for Western science. Aristotle saw nothing absurd in granting each event both an efficient cause (a mechanism, in our terminology) and a final cause (a purpose). He writes, for example, "Light shines through a lantern. Being composed of particles smaller than the pores of the lantern, it cannot help passing through them (assuming that this is how the light is propagated); but it also shines for a purpose, so that we may not stumble [*Posterior Analytics*, 94b, l. 28]." We can follow Aristotle for devices constructed by humans for definite purposes. We did put holes in lanterns to let the light through. Final cause also remains a legitimate concept for the adaptations of organisms, even though these features arise by natural processes and not by any conscious activity of the animals involved. It remains good vernacular English to say that bats and birds have wings "for" flight, and the wolf legitimately invoked final cause in replying to Red Riding Hood's inquiry about the sharpness of his teeth, "All the better to eat you with, my dear."

But we balk at ascribing final causes to the physical workings of inanimate objects, although Aristotle did not. Aristotle was comfortable with the idea that "it thunders both because there must be a hissing and roaring as the fire is extinguished, and also (as the Pythagoreans hold) to threaten the souls in Tartarus and make them fear [ibid., 94b, l. 34]." We chuckle at Aristotle here, and that chuckling represents perhaps the greatest change that science has undergone in modern times. We no longer view the universe as explicitly designed in all its minor and multifarious parts to serve some human purpose. We have replaced this cosmic hubris with a more mechanical view of nature. God may have wound the clock and established the laws of ticking at the outset, but he surely does not spend his precious time fashioning each blade of grass and grain of sand to provide explicit instruction or sustenance for his favored species on earth. The mechanical view, based on the primacy of efficient causation, has properly banished final cause from the domain of natural, physical objects.

So absolute is this proscription of final cause, and so essential to a modern definition of science, that old passages about the final causes of physical objects are unsurpassed as targets of ridicule when, in our arrogant approach to history, we choose to flay the past, all the better to bask in our current wisdom (a legitimate final cause in human psychology). It would, indeed, be hard to deny that many of these passages are, well, simply funny.

Louis Agassiz, for example, seriously argued in the 1860s that ice ages could be understood both by the physics of glacial motion (efficient cause) and as a dispensation of divine benevolence designed to churn and enrich the soil:

> One naturally asks, What was the use of this great engine set at work ages ago to grind, furrow, and knead over, as it were, the surface of the earth? We have our answer in the fertile soil which spreads over the temperate regions of the globe. The glacier was God's great plough.

In 1836, William Buckland, Oxford's first academic geologist, claimed that abundant coal, the fuel of England's glory, was so cleverly distributed in the bowels of the earth that God himself must have placed it there, many million years ago, in loving preparation for its future use. We might rightly suspect that as old rock, coal should now be buried under so many miles of younger strata that it would lie beyond our reach. But God saw fit to have it deposited not in vast horizontal sheets but in discontinuous bowl-shaped basins whose edges still intersect or lie just a bit below the

SUBARU OFFERS GREATER TRACTION. AND EVEN GREATER TRACTION.

We congratulate all the car makers who've finally noticed that front wheel drive improves traction. We, however, introduced front wheel drive in 1969. And we just don't think there's any substitute for experience.

As pioneers of front wheel drive, we use this experience to balance all the factors — drive train, steering, weight distribution, suspension — which make for remarkable adhesion to the road. Even around curves, in rain or snow.

The people of Maine, Idaho, Alaska and West Virginia think so much of our front wheel drive that they've helped make Subaru the best selling import in those states.[†] States where good traction is absolutely essential.

But if you want even more traction, we suggest our wagon with *On Demand* Four Wheel Drive. Which allows you to go from front wheel drive to four wheel drive with the flick of a lever. On Demand. Without stopping.

(Any other 4 wheeler around requires a full stop before switching. And stopping is exactly what you can't do sometimes.)

Both models also help you keep things under control when it comes to gas mileage. So while you're holding on to the road, you can also hold on to your money.

31 EPA EST. MPG.*

And both offer plenty of room, with plenty of options, like power windows, power steering, AM/FM cassette tape deck, cruise control. The works.

44 EPA EST. HWY.*

But the best option of all is deciding what level of traction you want. Greater. Or even greater.

SUBARU®

INEXPENSIVE. AND BUILT TO STAY THAT WAY.

4WD WAGON
$7,109**
FWD WAGON
$6,359**

[†] 1981 YTD REGISTRATIONS JUNE 1981 R.L. POLK AND COMPANY REPORT

[*] 1982 EPA ESTIMATES FOR OUR FWD 5-SPEED WAGON. USE EST. MPG FOR COMPARISIONS. YOUR MILEAGE MAY DIFFER DEPENDING ON DRIVING SPEED, WEATHER CONDITIONS AND TRIP LENGTH. ACTUAL HWY. MILEAGE WILL PROBABLY BE LESS.

[**] TOTAL SUGGESTED POE FOR OUR DL MODELS — NOT INCLUDING DEALER PREP, INLAND TRANSPORTATION, STATE AND LOCAL TAX, LICENSE AND TITLE FEES. CERTAIN ITEMS SHOWN OPTIONAL AT EXTRA COST.

© SUBARU OF AMERICA, INC 1982

Do you know these people?

NOT TRANSFERABLE
SEE REVERSE SIDE
AMERICAN EXPRESS
3712 345678 95014
78 AX
LUCIANO PAVAROTTI
NOT VALID IF CANCELLED OR REVOKED
ROBERTA PETERS
3712 345678 95047
77 AX
JIM HENSON
3712 345678 95063
62 AX
EDWARD R SCHWINN JR
3712 345678 95023
72 AX
JACK W NICKLAUS
3712 345678 95031
61 AX
BILL BLASS
3712 345678 95058
59 AX

If the world is divided into the "haves" and the "have nots," these people certainly have it. And you may be able to have it too. Simply follow in their footsteps and fill out an application.

The rewards are well worth the little time it takes. Like $75,000 automatic travel insurance, 24-hour Card replacement, emergency money, and an entree to over 1,000 American Express Travel Service Offices* around the world.

Just fill out the postpaid, self-addressed application facing this page. If it has already been torn out, just call (800) 528-8000 and we'll send you another immediately. We can't accept the entire world, but then you wouldn't want us to either. **The American Express® Card. Don't leave home without it.**℠

*Subsidiaries or Representatives of American Express Company worldwide.

© American Express Company, 1981

They had to fill out an application, too.

American Express® Card Application

PLEASE PRINT CLEARLY

Your Personal Data

First, Middle, Last Name — Title (optional) ☐ Mr ☐ Mrs. ☐ Miss ☐ Ms

Date of Birth	Number of Dependents	Social Security Number

Your Home Address—Personal Reference

Street Address

City, State and Zip Code

Home Phone (Area Code)	Years There	Own Home ☐ Rent ☐

Previous Home Address	Years There

City, State and Zip Code

Nearest Relative or Friend Not Living With You	Relationship

Street Address

City, State and Zip Code

Your Job

Employer or Firm Name

Nature of Business

Position	Years There

Street Address

City, State and Zip Code

Business Phone (Area Code)	Self-Employed ☐
If Employed By Above Less Than 3 Years Previous Employer or College/University	Years with Firm or Graduation Date

Street Address

City, State and Zip Code

Your Income

Your Annual Earnings

If there are other sources of income you would like us to consider, please list the income, source and person (Banker, Broker, Employer, etc.) to whom we can write for confirmation. (Alimony, separate maintenance or child support need not be revealed if you do not wish to rely on it.)

Amount Source

Name

Address

Credit References

List Credit Cards	Account Number

Other Credit Reference

Bank (Company Accounts Show Company Banks)

Bank Address, Street

City, State, Zip Code

Type of Account	Account Number

Bank (Company Accounts Show Company Banks)

Bank Address, Street

City, State, Zip Code

Type of Account	Account Number

Type of Account Wanted

☐ Personal Account ☐ Company Account Bill to: ☐ Home ☐ Office

Billing Address

City, State Zip Code

Additional Cards–Personal Accounts

For only $20 a year (in addition to your Basic membership fee), you can obtain American Express Cards for qualified members of your household or your dependents. They must be at least 18 years of age. Each agrees, by signing below, to the exchange of credit information about them and the same agreement printed above the basic applicant's signature.

First, Middle, Last Name

Street Address

City, State and Zip Code

Social Security Number

Signature of Additional Applicant

Print your name below as it should appear. Spell last name completely. Full name must not exceed 20 spaces.

045-00-0034-4

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

AN APPLICANT, IF MARRIED, MAY APPLY FOR A SEPARATE ACCOUNT.

By signing below, I ask that an account be opened for me and Card(s) issued as I request, and that you renew and replace them until I cancel. I understand that you may verify and exchange information on me and any additional applicants, including requesting reports from credit reporting agencies. I am aware that this information is used to determine my eligibility for the Card and that, if my application is approved, you may contact these sources to update this information at any time. If I ask whether or not a credit report was requested, you will tell me, and if you received a report, you will give me the name and address of the agency that furnished it. I will be bound by the Agreement received with each Card, unless I cut the Card in half and return both halves to you. If this is a personal account, I agree, or if this is a company account, both I and the company agree, to be liable for all charges to the basic and additional Cards issued on my request. And each additional Cardmember will be bound by the Agreement received with the Card and will be liable for all charges to that Card.

Signature of Applicant Date
X

For Company Account, Signature of Authorizing Officer Required Title
X

Do not enclose $35 annual fee, or additional Card fee ($20 for each additional Personal Card, $35 for each Company Card). We will bill you later.

© 1981 American Express Company

FOR FASTER PROCESSING, PLEASE FILL OUT COMPLETELY AND BE SURE TO SIGN THIS APPLICATION

FOLD, MOISTEN HERE, SEAL AND MAIL.

AMERICAN EXPRESS
3112 3456 78 9500б
58 AX
C F FROST
AMERICAN EXPRESS

The American Express Card. Don't leave home without it.℠

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 5789 PHOENIX, AZ

Postage will be paid by Addressee

AMERICAN EXPRESS CO.
P.O. BOX 13802
PHOENIX, AZ 85002

earth's surface. Moreover, the strata that were buried at inaccessible depths have often been extensively faulted and uplifted to the surface. These faults are a further boon to miners because the streams that often run along their fractured boundaries can guide us to the precious substance underneath, and because destructive fires can no longer ravage an entire field when faults break an extensive stratum into several discontinuous segments separated by rock that will not burn. Buckland wrote:

> However remote may have been the periods, at which these materials of future beneficial dispensations were laid up in store, we may fairly assume that . . . an ulterior prospective view of the future uses of Man formed part of the design, with which they were, ages ago, disposed in a manner so admirably adapted to the benefit of the Human Race.

Alexander Winchell, prominent American geologist and first chancellor of Syracuse University, could scarcely contain himself in paying lyrical tribute (in *Sketches of Creation*, 1870) to the faults that bring coal within our orbit:

> Buried ten thousand feet from view, man would never have learned of its existence, much less would he have known how to raise it to the surface. See the provision of Nature in breaking up the coal-bearing strata and tilting them on edge, as much as to say, "Lo! here is your desire; search not in vain; dig, and be satisfied with warmth; drive forth the hidden energy . . . and bid the servants furnished to your hands execute all the behests of your convenience."

I have, needless to say, no desire to resurrect this tradition of argument about final causes. But I would condemn, for two reasons, any attempt to parade old passages about final cause as a source for ready laughter and self-congratulation in transcending past ineptitude. First, it subverts any effort to understand the past and use it as a guide for interpreting the present. When such fine intellects as Agassiz and Buckland (not to mention Aristotle) seriously advance these arguments, we must view them as markers of a fundamentally different conception of the world, not as signs of personal stupidity or general naïveté. Second, even failed views of the world, when they have both grandeur and depth, can serve as wonderfully fruitful sources of insight. To recycle a favorite quote used once before in these columns: "Give me a fruitful error any time, full of seeds, bursting with its own corrections. You can keep your sterile truth for yourself" (Pareto's comment on Kepler).

Final cause served as such a fruitful error at a crucial moment in my own profession. The greatest reconstruction of geology—James Hutton's theory of the earth—rested squarely on an argument about final causes. And few geologists have the slightest inkling of this "antiquated" wellspring of insight because it has been subverted by a comfortable (and comforting) myth that locates the source of Hutton's success in his pursuit of modern tactics—fieldwork and a mechanical concept of physical causality (see G.L. Davies, *The Earth in Decay* [American Elsevier, 1969], for a fine account of this myth and its correction).

Born in Edinburgh in 1726, James Hutton hobnobbed with the likes of David Hume, Adam Smith, and James Watt in the great Scottish intellectual circle that so influenced the life of eighteenth-century Europe. After abandoning an apprenticeship in law, he studied medicine. As a man of means, he felt no need to practice and opted instead for farming (on land inherited from his father and after bolstering his economic security by inventing and marketing a process for producing sal ammoniac from chimney soot). No rustic he, but no gentleman farmer either, he studied the latest methods in husbandry and ran a profitable, modern, model farm. In his early forties, Hutton gave up country life, returned to Edinburgh and spent the remaining three decades of his life as a full-time unemployed, intellectual gentleman.

In 1788, Hutton published his reconstruction of geology in the first volume of the *Transactions of the Royal Society of Edinburgh* (expanded in 1795 to a multivolumed work entitled *Theory of the Earth*, following a blistering attack for supposed atheism and other improprieties by the Irish chemist and mineralogist Richard Kirwan). Hutton, although usually cast as a modern empiricist, really belongs to the great tradition of comprehensive (and at least partly speculative) system building that dominated most of eighteenth-century "geology" (the term had not yet been invented, and no profession, with formally recognized procedures, then existed).

Hutton's system, his "world machine," embodied a cyclical notion of history—dynamic and endlessly recurring, but moving nowhere, as the Preacher of Ecclesiastes proclaimed:

> All the rivers run into the sea; yet the sea is not full. Unto the place from whence the rivers come, thither they return again [1:7]. The thing that hath been, it is that which shall be; and that which is done, is that which shall be done; and there is no new thing under the sun [1:9].

This view of history contrasted sharply with the more familiar Christian concept of a linear and directional sequence moving ever onward from creation to resurrection. (Hutton, who was decidedly not an atheist, did not deny that God had ordained a beginning and would decree an end. But these miraculous events lie outside the purview of science. In between these singularities, God rested and permitted the world to run by the natural laws that he had established. Only this period could be studied by science, and here Hutton discerned no direction, but only endless cycling.)

Hutton's theory rests, in part, on his choice of metaphors for the earth. With friendship for James Watt and with reverence for Isaac Newton, Hutton chose to see the world as a perfect machine that, once wound, would run forever (or until God changed the rules) without wearing out or breaking down. "This world," Hutton proclaimed,

> is an active scene or a material machine moving in all its parts. We must see how this machine is so contrived, as either to have those parts to move without wearing or decay, or to have those parts, which are wasting and decaying, again repaired.

Hutton therefore contrived a four-stage, cyclical theory of earth history. In the first stage, the only one we can observe directly, the land is worn away by erosion and eventually (stage two) deposited as strata in the depths of the ocean. There (stage three), the strata are compacted and consolidated by heat (both from the interior fires of the earth and from the weight of overlying sediments), and then (stage four), as a result of the same internal heat, fractured and uplifted to form new continents. Land and sea have changed places and the cycle starts again: erosion, deposition, consolidation, and uplift—forever and ever. Thus, in the most famous words ever written by a geologist, Hutton ends his 1788 treatise by explicitly comparing his world machine with the endless cycling of planets about the sun:

> Having, in the natural history of this earth, seen a succession of worlds, we may from this conclude that there is a system in nature; in like manner as, from seeing revolutions of the planets, it is concluded, that there is a system by which they are intended to continue those revolutions. . . .

> The result, therefore, of our present enquiry is, that we find no vestige of a beginning,—no prospect of an end.

Although Hutton had predecessors for each individual claim, the revolutionary content of his comprehensive system has two primary sources. First, he burst the boundaries of time, thereby establishing geology's most distinctive and transforming contribution to human thought—"deep time," as John McPhee puts it. In his next most famous statement, Hutton wrote: "Time, which measures every thing in our idea, and is often deficient to our schemes, is to nature endless and as nothing."

One of the major barriers to an acceptance of deep time had been the absence of any recognized restoring force in the operations of nature. Geologists before Hutton generally lacked a "concept of repair." They knew that erosion constantly wore down the land, and cultural traditions supported the idea of history as a continual decline from the original perfection of Eden. They did not recognize that the earth's internal heat could fracture and raise vast areas of the continents into mountains and high plains (they regarded mountain ranges as part of the earth's original structure and volcanoes as mere pimples on the globe's degrading surface). Without such a concept of repair, the earth must be very young. After all, it would not take long to erode all continents beneath the sea, and mountains still tower above us. As his second great contribution, Hutton demonstrated that igneous forces within the earth supplied a restorative power that uplifted continents, prevented the land's destruction, permitted a theory of endless cycling, and established the possibility of deep time.

For each of these contributions—deep time and a concept of repair—Hutton supplied a key empirical observation. For time, Hutton recognized the significance of what geologists call an angular unconformity. Old sedimentary rocks, originally deposited in horizontal sheets, are often uplifted and tilted during the operations of Hutton's restorative forces. They may then be eroded down, covered again by water, and overlain by a new sequence of horizontal sediments. The contact between these two packages of sedimentary rocks is called an angular unconformity because the tilted older strata meet the horizontal younger strata at an angle. Hutton rejoiced in these unconformities because they yielded direct evidence for his theory of cycles. Each angular unconformity recorded *two* Huttonian worlds placed in sequence one atop the other—an older world in the first package, made in the depths of the sea, uplifted, and eroded down again, and a younger world in the second package, made in a later ocean and now uplifted to our view. John Playfair, Hutton's greatest interpreter and the most literate man who ever wrote about geology, recorded his awe upon viewing an angular unconformity on a field trip with Hutton:

> What clearer evidence could we have had of the different formation of these rocks, and of the long interval which separated their formation, had we actually seen them emerging from the bosom of the deep? . . . The mind seemed to grow giddy by looking so far into the abyss of time.

For a concept of repair, Hutton recognized the igneous nature of two common rocks, basalt and granite. Many geologists at the time argued that basalt and granite were sedimentary rocks, deposited from water; Hutton held (correctly) that they had risen as magma from the depths of the earth and cooled to their present state. Thus, they represented the products of Hutton's restorative force. This issue became the focus of a great struggle in science, the debate between Neptunists, who advocated water, and Plutonists (like Hutton), who opted for internal fires as the source of granite and basalt. The debate received a good popular press and even spilled onto the pages of *Faust* (Goethe being, among other things, a brilliant geologist) where, from the error of its author, Faust argues for water and Mephistopheles (only appropriately) for fires within the earth. Arcane scientific debates don't receive this much notice unless the stakes are high—and indeed they were. Basalt and granite occupy vast areas of the earth's surface. If they, like all other common rocks then recognized, are sedimentary, then all rocks may be products of an original ocean, and the entire history of our earth may be short and directional—a few thousand years of deposition and drying out. But if granite and basalt are igneous, then they record a restorative force of sufficient power to cover much of the earth with its products. History may be cyclical and long. Hutton relied primarily upon field evidence for his Plutonian conclusions. He noted, in particular, that granite and basalt often occur as vertical dikes cutting through horizontal sediments and marking the passageway of magmas from the earth's interior.

Did Hutton base his general theory upon these observations? Did he triumph, as the usual story goes, because he was an objective modernist who combated ancient traditions of prejudiced speculation by using the "real" scientist's tool of pure and unfettered observation, and by holding a modern concept of mechanical causality? Hutton's countryman the great Scottish geologist Sir Andrew Geikie gave this common myth its strongest support in his 1905 volume, *The Founders of Geology*. Geikie wrote: "In the whole of Hutton's doctrine he rigorously guarded himself against the admission of any principle which could not be founded on observation. He made no assumptions. Every step in his deductions was based upon actual fact." Geikie's heroic Hutton gathered his facts by the method that provides both the strength and the mystique of geology—fieldwork:

> He went far afield in search of facts, and to test his interpretation of them. He made journeys into different parts of Scotland. . . . He extended his excursions likewise into England and Wales. For about thirty years, he had never ceased to study the natural history of the globe, constantly seeking to recognize the proofs of ancient terrestrial revolutions, and to learn by what causes they had been produced.

This Hutton matches the idealized image of geology presented to generations of students, but it bears little relation to the original. To be sure, Hutton did not remain perennially in his armchair. He made many excursions and saw many things. His observations no doubt inspired and instructed him; but we can show, also without doubt, that fieldwork was not the source of his theory. For his two key observations, the chronology of the official myth is backward. Hutton saw his first angular unconformity after he had presented his full-blown theory in public. Moreover, by his own admission, he had observed granite in only one uninformative place before publishing his theory. Fieldwork, at best, provided confirmation for a theory developed elsewhere.

When we consult Hutton's written record, we find—if we may take his own presentation at face value—that he developed his general theory by the accepted route of eighteenth-century system builders: he reasoned from his own version of first principles and then gathered arguments for what he regarded as necessary conclusions. And when we examine Hutton's concept of first principles, we find that he was not a mechanist committed to empirical test, but a follower of Aristotle's notion of causality.

Hutton did have a mechanical concept of causality; his earth is a perfect

J&B. It whispers.
RARE
LENDED SCOTCH WHISK
100% SCOTCH WHISKIES
BLENDED AND BOTTLED IN SCOTLAND BY
& BROOKS
Street, London, Eng
MERCHANTS TO THEIR LATE MAJESTIES
KING GEORGE III
ORGE IV
LLI IV
CTORIA
KING ED
KING GE
KING
J&B

1981 [illegible] Corp., NY

machine, working with no hint of senescence until God chooses to ordain an end. But Hutton followed Aristotle in arguing that events have *both* a mechanical (or efficient) cause and a purpose, or final cause. Of the two, Hutton clearly regarded final causes as more important and more fundamental to his system. When Geikie and others chose to ignore Hutton's own writing, and to use him as a moral homily for an idealized view of science, they did major disservice to a great, if not a modern, intellect.

The very first paragraph of Hutton's great work (the original 1788 version), in emphasizing both machines and purposes, advances the Aristotelian argument that any adequate theory of the earth must explain both how and why:

> When we trace the parts of which this terrestrial system is composed, and when we view the general connection of those several parts, the whole presents a machine of a peculiar construction by which it is adapted to a certain end. We perceive a fabric, erected in wisdom, to obtain a purpose worthy of the power that is apparent in the production of it.

In the fourth paragraph, we learn that the earth's final cause must be expressed in terms of fitness for its sentient inhabitants, namely us: "This globe of the earth is a habitable world; and on its fitness for this purpose, our sense of wisdom in its formation must depend."

Hutton then explains how he developed his general theory of the earth as a self-restoring machine with a cyclical history of erosion, deposition, consolidation, and uplift. He appeals neither to field observations nor to mechanical causes but bases his argument on a puzzle arising from his own experience as a farmer and centered squarely on the idea of final cause. We may refer to this puzzle as the "paradox of the soil."

Without soil for agriculture, we could not support ourselves on this planet. Soil is a product of erosion, the destructive phase of the Huttonian cycle:

> A solid body of land could not have answered the purpose of a habitable world; for a soil is necessary to the growth of plants; and a soil is nothing but the materials collected from the destruction of the solid land. . . . The heights of our land are thus leveled with the shores; our fertile plains are formed from the ruins of mountains.

Now, the paradox. To form the soil so necessary for our lives and, therefore, so essential to the earth's final cause, nature uses a mechanical process that must destroy the land: "We are, therefore, to consider as inevitable the destruction of our land, so far as effected by those operations which are necessary in the purpose of the globe, considered as a habitable world." But God would not play such a joke on his favored creatures. He could not employ as a source of life-giving soil a process that must soon obliterate all humanity by washing our land into the sea. A restorative force must exist a priori, so that the earth may display wisdom in its adaptation for human life:

> If no such reproductive power, or reforming operation, after due enquiry, is to be found in the constitution of this world, we should have reason to conclude, that the system of this earth has either been intentionally made imperfect, or has not been the work of infinite power and wisdom.

Hutton did not find his restorative force unexpectedly in the field by stumbling upon an angular unconformity or pondering the nature of granite. He deduced the necessity of a restorative force from a threatening paradox in final cause, and then set out to find it. Indeed, he portrays his entire treatise as an earnest search for this necessary defense of purpose among physical objects:

> This is the view in which we are now to examine the globe; to see if there be, in the constitution of this world, a reproductive operation, by which a ruined constitution may be again repaired, and a duration or stability thus procured to the machine, considered as a world sustaining plants and animals. . . . Here is an important question . . . a question which, perhaps, it is in the power of man's sagacity to resolve; and a question which, if satisfactorily resolved, might add some lustre to science and the human intellect.

When Hutton locates his restoring forces in the earth's internal fire, he continues the Aristotelian strategy of identifying both how they work and why, in human terms, they operate as they do:

> The end of nature in placing an internal fire or power of heat, and a force of irresistible expansion, in the body of this earth, is to consolidate the sediment collected at the bottom of the sea, and to form thereof a mass of permanent land above the level of the ocean, for the purpose of maintaining plants and animals.

Volcanoes, Hutton tells us, are "not made on purpose to frighten superstitious people into fits of piety and devotion, nor to overwhelm devoted cities with destruction." They are escape vents for internal fires, "spiracles to the subterranean furnace, in order to prevent the unnecessary elevation of land, and fatal effects of earthquakes." Some may die in their eruptions, but only so that more may live: "While it may occasionally destroy the habitations of a few, it provides for the security and quiet possession of the many."

Hutton's contemporaries certainly understood the central role of final cause in his theory, both as an original motivation and a sustaining theme. Playfair wrote of his treatise: "We see everywhere the utmost attention to discover, and the utmost disposition to admire, the instances of wise and beneficent design manifested in the structure, or economy of the world." Hutton, he continued, regarded final causes as preeminent:

> They were the parts . . . which he contemplated with greatest delight; and he would have been less flattered, by being told of the ingenuity and originality of his theory, than of the addition which it had made to our knowledge of final causes.

I am not, of course, suggesting that final cause be readmitted into science as a component for the explanation of physical events. I merely wish to point out that although theories may be winnowed and preserved empirically, their sources are as many as people and times and traditions and cultures are varied. If we use the past only to create heroes for present purposes, we will never understand the richness of human thought or the plurality of ways of knowing.

Final cause inspired the greatest of all geological theories, but we may use it no longer for physical objects. This creative loss is part of Darwin's legacy, a welcome and fruitful retreat from the arrogant idea that some divine power made everything on earth to ease and inform our lives. The extent of this loss struck me recently when I read a passage from the work of Edward Blyth, a leading creationist of Darwin's time. He wrote of the beauty and wisdom "so well exemplified in the adaptation of the ptarmigan to the mountain top, and the mountain top to the habits of the ptarmigan." And I realized that this little line expressed the full power of what Darwin had wrought—for while we may still speak of the ptarmigan adapting to the mountain, we may no longer regard the mountain as adapted to the ptarmigan. In this loss lies all the joy and terror of our current view of life.

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

A whole world of nature—in the unique all-photographic, all full-color

Audubon Society Field Guides

The groundbreaking and spectacular series that began with the *Audubon Society Field Guide to North American Birds* now covers every kind of creature and plant (and mineral and shell) that American nature-lovers love to identify!

The entire series follows the unique style set by *Birds* (which alone has sold more than 1,000,000 copies to date): in each guide, all the identification pictures are full-color photographs.

A *live* bird, butterfly, reptile, or wildflower, for example, brilliantly photographed in color in its natural habitat—at last you can see in a field guide exactly what you see in the field.

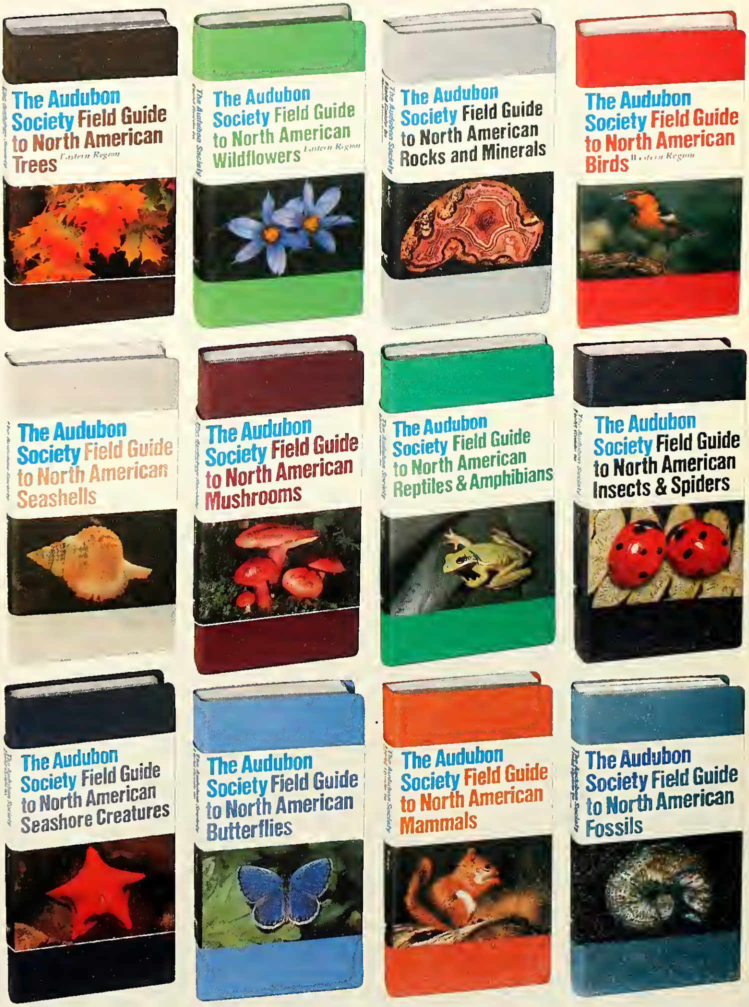
In every way, the series is extraordinary:

- Each of the guides contains *hundreds* of full-color photographs
- Each has 639 to 989 pages, with flexible sewn binding—and fits in your pocket!
- Each is organized visually (by color and/or shape) for quick identification in the field
- The richness of information (more than 400 pages of text alone in each book) is unrivaled

There are no other field guides like these—at once so beautiful, so easy to use, and so informative.

Here are all the titles:

TREES
Eastern and Western editions
WILDFLOWERS
Eastern and Western editions
ROCKS AND MINERALS
BIRDS
Eastern and Western editions
SEASHELLS
MUSHROOMS
REPTILES AND AMPHIBIANS
INSECTS AND SPIDERS
SEASHORE CREATURES
BUTTERFLIES
MAMMALS
And, coming in July
FOSSILS


The Audubon Society Field Guide to North American Trees Eastern Region
The Audubon Society Field Guide to North American Wildflowers Eastern Region
The Audubon Society Field Guide to North American Rocks and Minerals
The Audubon Society Field Guide to North American Birds Western Region
The Audubon Society Field Guide to North American Seashells
The Audubon Society Field Guide to North American Mushrooms
The Audubon Society Field Guide to North American Reptiles & Amphibians
The Audubon Society Field Guide to North American Insects & Spiders
The Audubon Society Field Guide to North American Seashore Creatures
The Audubon Society Field Guide to North American Butterflies
The Audubon Society Field Guide to North American Mammals
The Audubon Society Field Guide to North American Fossils

Ask your bookseller to show you the guides. We think you'll agree that at $12.50 each they're a bargain as well as a joy.

Where to get your copies

They're available wherever books are sold. Or send us your order and check, with the title(s) you want and your name and address clearly printed. Add $1 postage for first book (or $2 total postage if you order more than one) plus sales tax where applicable. Write to Dept. NH, Alfred A. Knopf, Inc., 201 East 50 Street, New York, N.Y. 10022.

$12.50 each
Produced by
Chanticleer Press

Published by
Alfred•A•Knopf

Mount St. Helens Revisited

Food and shelter are still not abundant, and the volcano continues to rumble, but many kinds of animals—both survivors of the eruption and recent immigrants—are making efforts to repopulate the mountain

by James A. MacMahon

For many years to come and certainly long after the second anniversary of its May 18, 1980, eruption, Mount St. Helens will continue to provide scientists with an incomparable opportunity to observe natural repair processes at work. Yet the task of deciphering the story of life on the volcano has turned out to be more difficult than many scientists ever envisioned. Instead of an affected area of about 160 square miles that could be subdivided into three or four neat devastation categories, researchers have found that nearly every patch of ground must be sleuthed to reconstruct the causes of its fate since the eruption. Was the site forested, clear-cut, or above timberline before the big event? Was it snow covered on the morning of the May 18 eruption? Did it receive only a shower of pumaceous material or was it subjected to the full fury of the mixture of hot gas and rock material known as pyroclastics?

Adding to the difficulties of reconstructing the past are the problems of predicting the future. It is impossible to tell what the future activity of the volcano will be, and a sizable eruption would probably destroy many of the present scientific study sites. Even as we go to press, the mountain is rumbling, and scientists disagree as to whether the volcano's dome is about to erupt or whether Mount St. Helens is in for a period of intensive dome building. One thing is sure, however. If the volcano erupts now or at some future time, plants and animals—and scientists—will undoubtedly return to the mountain and start their work again. Certainly all three groups have been busy since the mountain blew two years ago.

Survival of plant and animal life in the areas devastated by the May 18 blast was often due to a chance set of circumstances, which no one could have modeled mathematically and which were independent of the myriad adaptations organisms possess as a result of thousands of generations of evolution. A few hundred feet above Spirit Lake, for example, the presence of a single rock outcrop in the middle of the most ravaged lands seems to have permitted the survival, virtually unchanged, of an oasis containing the normal mix of plants and animals. The isolation of these islands of survivors may lead to genetic differences between populations derived from the survivors and more widespread populations of the same species. Such areas might also form a source from which organisms can recolonize the landscape faster than if recolonization occurred only from the perimeter of the large devastated area.

Being alive on May 19, 1980, however, was no guarantee of continued survival. Today, two types of organisms occupy the affected areas of Mount St. Helens: survivors (or their offspring) and colonizers. Those that lived through the original catastrophe may have been protected by the deep snow that was still present on some sites, or they may have been dormant in belowground burrows or safely ensconced at the bottom of a montane lake. Continued survival depended on the nature of the changes in their environment and their ability to cope with those changes. Many of the animals seen on the earliest reconnaissance missions in the summer of 1980 were not present in the spring of 1981. Some of those that have persisted have gone on to recolonize other parts of the volcano. Colonizers have also come from outside the regions affected by the eruption.

Because chance may spare a site within a devastated area and because survivors at one site may be colonizers in another, neither the types of organisms nor the categories of devastation are completely clear. Nevertheless, these categories and types can help clarify what happened during—and since—the eruption.

As Mount St. Helens erupted, its north slope broke up. Great chunks of the mountain and glacial ice flowed northward and westward in landslides and a debris flow that eventually turned into mud flows. A major tongue of this flow was directed into Spirit Lake, causing it to slosh up the side of its basin and scour the hills down to the bedrock in some areas. A more westerly directed arm followed the valley up the North Fork of the Toutle River. This landform contains blocks of material standing more than 90 feet above the surrounding area. The flow, as thick as 300 feet in some areas, averages more than 120 feet thick over a total area of about 23 square miles. Apparently no organisms were able to survive the mechanical damage caused by an overburden of this magnitude.

Damage caused by the blast itself depended on the distance from the volcano. The affected areas are characterized, in a very general sense, as the blast, or near, zone where trees were completely removed; the blowdown, or intermediate, zone where trees were leveled; and a scorch, or outer, zone where trees still stand but were scorched. Close to the volcano, many areas were also subjected to the high temperatures of pyroclastic flows and surges (hot mixtures of gases, ash, and up to boulder-size pumice and rock). Temperatures beneath the surface of materials deposited by these flows often exceeded 480°F—precluding the survival of organisms and creating some of the most desolate vistas on the volcano.

The volcano also deposited ash and other airborne materials. Beyond the scorch zone this is the only effect of the eruption. In such areas, including places on the relatively unaffected south slope of the volcano itself, the list of plant and animal species remains nearly the same as during preeruption times, although each species is often represented by fewer individuals. For example, at Butte Camp, on the south slope, Roger del Moral, Larry Bliss, and others at the University of Washington have compiled a plant species list that is virtually

FOR FLIGHTS OF IMAGINATION.

Take off in a legend called Thunderbird.

Imagine a car with this much luxury. Whose very name is a benchmark of prestige. Where comfort is aided by a richly appointed interior.

Welcome to a legend called Thunderbird. Where your personal driving environment is limited only by the reach of your imagination.

Just consider these innovative options: Push-button keyless entry that locks and unlocks doors and decklid with your own private code.

E
M
S
R
12:52
SUN 1
TIME
TRIP
ECON
FUEL

Electronic instrumentation with digital speedometer, fuel gauge and clock. A Tripminder® Computer with digital readouts for average speed, distance per gallon, fuel used, and trip average distance per gallon. Thunderbird even offers pivoting front vent windows — a convenience so many cars have long forgotten.

And now, consider a new kind of thunder. An optional 3.8 liter V-6 with the power of Ford's small V-8. It works in combination with an automatic overdrive transmission.

Imagine all this available in one car. See your Ford Dealer to buy or lease a 1982 Thunderbird... and let your flights of imagination come true.

THUNDERBIRD

FORD DIVISION Ford

Seat belts save lives — buckle up.

THUNDERBIRD Ford

You are invited to take an incredible journey deep inside . . .

The Human

Amazing microphotography, exacting illustrations, and fantastic x-ray tomographs—like the one below—take you through the mysterious labyrinths of the human psyche.

THE BRAIN
Mystery of Matter and Mind
an Body
Right cerebral hemisphere of brain
THE SKELETON
Fantastic Framework
MUS
The Magic
Right atrium
Left atrium
Mitral ring
Tricuspid ring
Right ventricle
Left ventricle
Superficial sinospiral
Deep sinospiral
Right pulmonary arteries
Pulmonary artery

A patient's head disappears into the maw of a PETT scanner bristling with photon detectors. Each machine costs several million dollars and requires thirty people to produce one diagnostic scan.

ple at the Mayo Clinic in Rochester, Minnesota, where the machi- was developed. The cost of this agile instru- to 5 million, could prove a drawback to ng a standard diagnostic tool

143

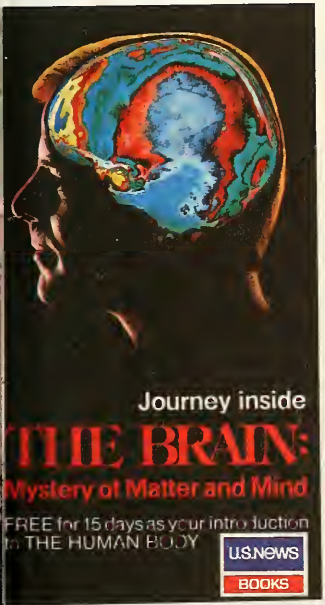
Spiraling bands of muscle wrap and power the ventricles of the heart, left. The heart divided into sections, right, reveals the positions, sizes and shapes of its walls and four chambers.

arrives through the body's two major veins, the superior and inferior venae cavae, and from the many minute blood vessels that drain blood from the walls of the chamber itself. The atrial walls form a small, smooth dome of muscle with a pouch of folded tissue, the right auricle, perched near the top. Along the inner surface of the auricle, bundles of muscle called musculi pectinati line up in parallel ridges like the teeth of a comb.

The right atrium holds about three-and-a-half tablespoons of blood. Its walls are less than an eighth of an inch thick. Two layers of muscle form the right atrial wall. A superficial layer spans both atria, and an inner layer, composed of many small bundles, arches over the atrial cavity at right angles to the superficial layer.

From the right atrium, the dark, venous blood flows through the tricuspid valve to the right ventricle. A larger, stronger chamber than the atrium, the right ventricle holds slightly more than a quarter cup of blood. Its walls, which are a quarter of an inch thick, are composed of three spiraling layers of muscle: the superficial and deep sinospiral layers and the superficial bulbospiral layer. All three bands of muscle anchor firmly onto the skeleton of the heart.

Toward the top of the chamber, near the pulmonary artery, the inner surface


Journey inside
THE BRAIN:
Mystery of Matter and Mind
FREE for 15 days as your introduction to THE HUMAN BODY
U.S.News
BOOKS

Yes! I would like to examine, without obligation, *The Brain: Mystery of Matter and Mind.* Please send my copy for a FREE 15-day examination, along with my free copy of the *Guide to Family First Aid,* and enter my subscription to THE HUMAN BODY. If I choose to keep *The Brain,* I'll pay just $12.95 ($14.95 in Canada) plus shipping and handling charges. Then, about every two months, I'll receive another volume of THE HUMAN BODY. For each volume, I'll enjoy the same FREE 15-day examination privileges. There is no minimum number of volumes I must buy, and I may cancel my subscription any time simply by notifying you.

If I decide not to keep *The Brain,* I'll return it within 15 days, will not receive future volumes of THE HUMAN BODY, and will be under no further obligation. The *Guide to Family First Aid* is mine to keep in any case.

☐ Check here if you prefer the deluxe Collector's Edition, bound in genuine, top-grain leather, at only $21.95 ($23.95 in Canada) each plus shipping and handling.

Name________________________________

Address____________________Apt. No._______

City______________State_______Zip_______

Canadian residents: Mail card in envelope.

4A10

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 10131 WASHINGTON, D.C.

POSTAGE WILL BE PAID BY ADDRESSEE

U.S.News
BOOKS

U.S.News Books
Box 1776
Bergenfield, NJ 07621

Body

How do we think? What causes creativity? Where are memories stored? Why are emotions linked to cancer? Venture into the astonishing depths of the human mind with . . .

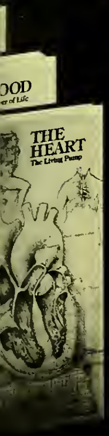
THE BRAIN

Mystery of Matter & Mind

YOURS FREE FOR 15 DAYS
as your introduction to
THE HUMAN BODY

FREE BONUS!
"GUIDE TO
FAMILY FIRST AID"
just for examining
THE BRAIN!

U.S.News BOOKS
GUIDE TO FAMILY FIRST AID



Every volume of
The Human Body...

- Measures a big 9 by 11 inches
- Has a beautiful cloth binding with gold foil stamping and padded library spine
- Contains 164 pages
- Features more than 150 illustrations, many in full color
- Includes a glossary of medical and scientific terms

NEW from U.S.NEWS & WORLD REPORT BOOKS

U.S.News & World Report invites you to embark on an extraordinary voyage of discovery—a journey through the frontiers of science, medicine and the most puzzling of all enigmas—the human brain.

From physiology to psychology, you'll explore every fascinating aspect of the body's most complicated organ...emotions and behavior... memory and learning...perception and understanding...intelligence and creativity. You'll meet Aristotle, Pavlov, Freud—all the pioneers who charted the unknown terrain of the mind. Never-before-published pictures, photo essays, and see-through brain maps take you through the mysterious labyrinths of the human psyche...and show you the amazing processes that enable us to think, feel, sense, react. It's all yours to discover in 164 colorful pages of THE BRAIN, your exciting introduction to THE HUMAN BODY.

Spectacular microphotography, computer scanning, specially commissioned picture essays, and see-through diagrams show you more than 4,000 body processes at work!

In vivid color and astounding detail, THE HUMAN BODY shows you the structures of the body as you've never seen them before—an invaluable reference library for the whole family! This amazing series spans 5,000 years of quest and discovery... and brings you to the space age labs where science fiction is becoming science fact. It's packed with indispensable, up-to-the-minute healthcare information, too—how to reduce your risk of heart attack, how to avoid the effects of stress, and much more.

To start your incredible journey, you're invited to examine THE BRAIN in your home FREE for 15 days without obligation. Don't wait—send in your order card today!

U.S.News BOOKS

Yes! I would like to examine, without obligation, *The Brain: Mystery of Matter and Mind*. Please send my copy for a FREE 15-day examination, along with my free copy of the *Guide to Family First Aid*, and enter my subscription to THE HUMAN BODY. If I choose to keep *The Brain*, I'll pay just $12.95 ($14.95 in Canada) plus shipping and handling charges. Then, about every two months, I'll receive another volume of THE HUMAN BODY. For each volume, I'll enjoy the same FREE 15-day examination privileges. There is no minimum number of volumes I must buy, and I may cancel my subscription any time simply by notifying you. If I decide not to keep *The Brain*, I'll return it within 15 days, will not receive future volumes of THE HUMAN BODY, and will be under no obligation. The *Guide to Family First Aid* is mine to keep in any case.

☐ Check here if you prefer the deluxe Collector's Edition, bound in genuine, top-grain leather, at only $21.95 ($23.95 in Canada) each plus shipping and handling.

Name ____________________
Address ____________________ Apt. No. ________
City ____________________ State ________ Zip ________

MAIL TO: U.S.News Books, Box 1776, Bergenfield, NJ 07621
Canadian residents: Mail card in envelope

4A09

FOUND!
IN GUARDED VAULTS!
5,000 ORIGINAL, U.S. GOV'T.
MORGAN SILVER DOLLARS
that escaped Gov't. meltdown!

Rare Surviving Hoard of Original U.S. Gov't. Coins
To Be Released To U.S. Citizens For Only $30 Each
...ACCEPTANCE DEADLINE: JUNE 7

E PLURIBUS UNUM
1880
UNITED STATES OF AMERICA
In God we trust
ONE DOLLAR

Tonight at midnight, history will be made when the National Monetary Center opens its vaults and releases to the public some of the last surviving ORIGINAL, U.S. GOV'T. MINTED MORGAN SILVER DOLLARS IN EXISTENCE IN ALL THE WORLD. Yes, a valuable hoard of 5,000 Morgan Silver Dollars . . that escaped Gov't. meltdown over a half a century ago . . . and have become one of the rarest coins on the face of the earth.

THE DAY THE SILVER DOLLAR ARMY MARCHED OFF TO WAR!

You see, in World War I, due to severe silver shortages, the U.S. Gov't. drafted from circulation and melted down some 270 million Morgan Silver Dollars. In one single action—"Operation Meltdown"—the Morgan suddenly became one of the rarest coins ever minted. Which is why the release of this hoard of 5,000 original U.S. Gov't. Morgans is such a significant event in the world of valuable coins.

FOR THE RELEASE TO INDIVIDUAL CITIZENS ONLY—
FOREIGN AND DEALER ORDERS WILL NOT BE HONORED!

Most significant, each of these original Morgan Silver Dollars, is guaranteed to "contain 412.5 grains of ninety per cent fine silver," to measure 38.1 mm in diameter with weight of 26.73 grams and will be accompanied by a Certificate of Authenticity to this effect for your own insurance purposes.

PRICE GUARANTEED FOR THIS SPECIAL RELEASE ONLY!
SUPPLY GUARANTEED FOR ONLY AS LONG AS THEY LAST!

Due to limitations of our available supply, and the acute scarcity of original U.S. Gov't. Morgan Silver Dollars still in good condition, we can only guarantee this initial offering price of $30 per coin plus $2 postage, handling and insurance per coin for this special release only.

In addition we must set a strict limit on no more than ten (10) original Morgan Silver Dollars per order, AND SINCE THIS OFFER IS BEING MADE AVAILABLE TO PRIVATE U.S. CITIZENS ONLY, NO ORDERS FROM DEALERS OR INDIVIDUALS FROM OUTSIDE THE UNITED STATES WILL BE ACCEPTED and uncashed checks will be returned.

But once again . . . this is a STRICT LIMITED OFFERING TO U.S. CITIZENS ONLY. All orders will be filled on a first-come, first-serve basis; and of course your purchase price refunded in full, anytime within 14 days if not completely satisfied. **SPECIAL COLLECTOR'S DISCOUNTS: 3 COINS for $75** plus $5 postage, handling & insurance; **5 coins for $120** plus $5 postage, handling & insurance; **10 coins for $225** plus $5 postage, handling & insurance. To avoid disappointment or future regret, you must place your orders immediately. ACT NOW!

NATIONAL MONETARY CENTER, DEPT. SWNM-33
Box 37438, WASHINGTON, D.C. 20013

NATIONAL MONETARY CENTER Inc. A private coin repository not affiliated with the U.S. mint or any gov't agency

identical to a typical list for alpine areas in that section of the Cascade Range. Notable animals at Butte Camp are a black bear that has persisted in the area since the time of the blast and pocket gophers that have reproduced within the last twelve months.

This is not to say that the ashfall had no consequences: John Edwards and Lawrence Schwartz of the University of Washington have demonstrated in the laboratory that ash, by causing physical scarification of insect cuticle and subsequent desiccation, can kill individuals much as some commercial silica-dust insecticides do. Ash certainly killed many insects, but after the eruption, numerous sites in the high-ashfall zones close to the blast area contained up to seven species of ants, a dozen spider species, and more than fifteen beetle species, all survivors. At one of the oases above Spirit Lake, where ash is more than six inches deep, I have seen ground-dwelling spiders, two millipede species, a centipede, three ant species, and several beetles.

Evidence for the effect of ash on vertebrates is also somewhat debatable. As far from the volcano as eastern Washington, David Pyke of Washington State University has found deer mice (*Peromyscus maniculatus*) with signs of eye swelling that may have been induced by ash. In contrast, Doug Andersen of Purdue University—my collaborator on Mount St. Helens—and I have found no eye swelling in deer mice from our Spirit Lake blast site or from any of our high-ashfall areas fifteen to twenty miles northeast of the crater. Furthermore, we found no lung damage in any of the dead animals we examined microscopically. Interestingly, in 1945, less than four inches of ash near Iliamna Lake, Alaska, reportedly led to the death of certain rodents, blindness in rabbits, and illness in reindeer.

Richard Mack of Washington State University has documented ashfall effects on vascular plants in Washington and Idaho more than ninety miles from Mount St. Helens. Ash deposits mechanically overloaded several species, killing some and burying the fruits and flowers of others. The ash may also have dusted the leaves of some plants in ways that altered the energy balance, causing the leaves to overheat and die. Mack believes that the most important effects of the ash may become more obvious in the future if compacted ash alters the nature of seed residence sites and the availability of seeds to seed predators.

The kind of disturbance experienced

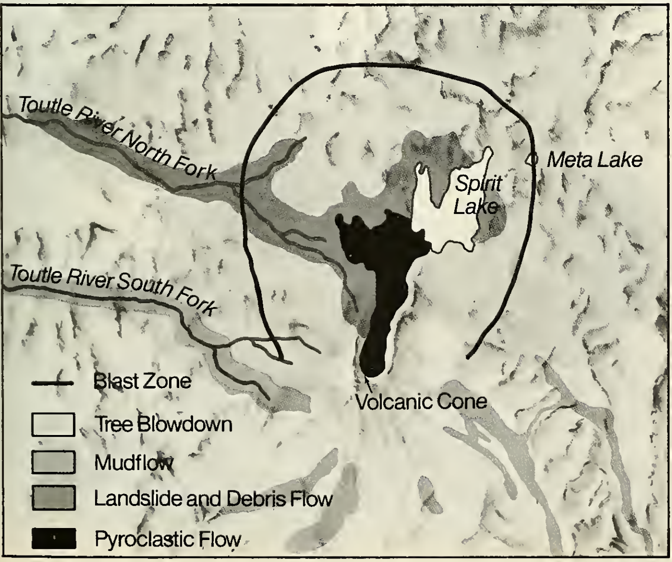
by an area influenced not only what survived but also what can now successfully colonize the site. Potential colonizers, however, must first get there. The animals and plants that have moved into affected areas of Mount St. Helens, whether from oases on the volcano or from outside, must have good dispersal mechanisms. The cysts and spores of myriad microorganisms, carried along by winds, fall on the volcano constantly. Some plant seeds and spiders are also passively dispersed by wind. Immature spiders of many species spin threads of silk that remain attached to their spinnerets. These parachutelike apparatuses carry the spiderlings "on gossamer wings" and are responsible for the presence of young orb-web weaving spiders on the debris flow, an area that still supports very little life. Highly mobile animals, such as birds and some large mammals, were able to move easily into many devastated areas within hours or days after the eruption.

For all these migrants, getting on the volcano is just the beginning of their problems. For most species, suitable home sites and food sources are not available. Wood-boring insects would appear to be an exception. The abundance of downed timber led to some anticipation of a boom of bark beetles (*Dendroctonus* spp.) and an infestation of nearby valuable timberlands, but to date this has not occurred.

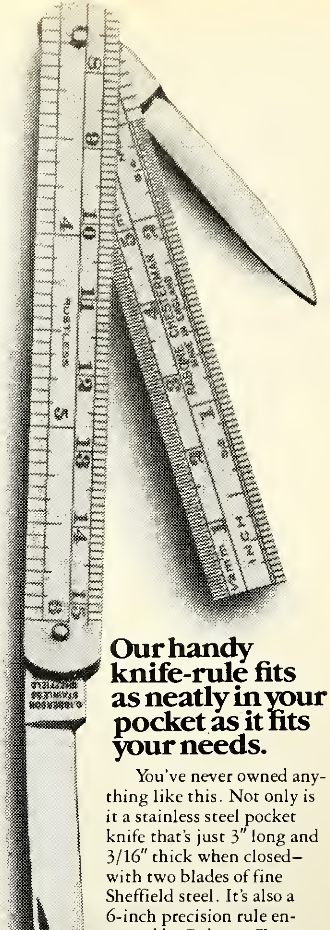
Not surprisingly, colonizers of all kinds are scarce in the blast area. There are few food resources: few plants or plant remains and thus few animals. My impression is that many of the invading invertebrates are predatory forms, an observation that agrees with findings at other sites highly altered by such agents as fire. Colonizers often include a high proportion of carnivores because primary plant productivity is lower than in better developed ecosystems. Collecting insects and spiders in the blast zone with any quantitative certainty, however, has been difficult since there is so little life of any sort. The exceptional places, such as the series of protected oases near Spirit Lake, are so small that I do not want to alter them by intensive study techniques.

In some parts of the blowdown zone, moving among the tangled trunks is so

Many factors, including chance, influenced the survival of plants and animals after the May 1980 eruption. In most of the blast zone, for example, devastation was nearly total, but the arms of Spirit Lake are dotted by a dozen or so oases—patches of vegetation a few yards across—that survived intact and now contain a normal mix of organisms. In other areas, only some species survived, and the composition of the community changed. Around Meta Lake, for instance, gophers survived the eruption but most plant life did not; unable to find food, the gophers had disappeared by the summer of 1981.



Joe LeMonnier



Our handy knife-rule fits as neatly in your pocket as it fits your needs.

You've never owned anything like this. Not only is it a stainless steel pocket knife that's just 3" long and 3/16" thick when closed—with two blades of fine Sheffield steel. It's also a 6-inch precision rule engraved by Rabone-Chesterman of England, who are known the world over for precision rules. But, the best part of all? You don't have to go any further than your pocket for it.

Send for the Garrett Wade Knife-Rule and our introductory catalog. It's full of fine woodworking tools.

Garrett Wade Co.,
Dept. 66
161 Ave. of the Americas
New York, N.Y. 10013

Please send me _____ pocket knife-rule(s) @ $27.50 p.p.d. plus introductory Garrett Wade Catalog.

☐ Check/Money Order enclosed.
☐ Visa/Master Charge/American Express.

Card No ________ Expires ________
NAME ________
ADDRESS ________
CITY ________
STATE ________ ZIP ________

Better Than Jogging

NordicTrack

Jarless Total Body Cardiovascular Exerciser
Duplicates X-C Skiing for the Best Motion in Fitness

Highly Effective and Pleasant To Use
The enjoyable sport of cross-country skiing is often cited by physiologists as the most perfect form of cardiovascular exercise for both men and women. Its smooth, fluid, total body motion uniformly exercises more muscles and higher heart rates seem easier to attain than when jogging or cycling. NordicTrack closely simulates the pleasant X-C skiing motion and provides the same cardiovascular endurance-building benefits — right in the convenience of your home. Makes a year round, consistent exercise program easily attainable. Eliminates the usual barriers of time, weather, chance of injury, etc. Also highly effective for weight control.

Better Than Running
NordicTrack gives you a more complete work out — conditions both upper body and lower body muscles at the same time. Fluid, jarless motion will not cause joint or back pains as jogging or running often does.

Better Than Exercise Bikes
NordicTrack's stand-up skiing motion more uniformly exercises large leg muscles and also adds important upper body exercise. Higher pulse rates, necessary for building fitness, seem easier to attain because the work is shared by more muscle mass. The NordicTrack also keeps more muscles in tone.

Even Better Than Swimming
NordicTrack more effectively exercises the largest muscles in the body, those located in the legs and buttocks. These muscles' main function is to lift and propel the body in the standing position. However, when swimming, the body is supported by the water, thus preventing these muscles from being effectively exercised. The stand up exercising position on the NordicTrack very effectively exercises these muscles.

A Proven, High Quality Durable Product
Ruggedly constructed, NordicTrack is quiet, motorless and folds compactly for storage. Separately adjustable arm and leg resistances. NordicTrack is in its 5th year of production and is used in thousands of homes and many companies. We manufacture and sell direct. Our No-Risk 15 day trial guarantee shows our confidence in your being pleased with the performance and quality of the NordicTrack.

For more information, call or write
PSI 124 L Columbia ct. Chaska, MN 55318
toll free 1-800-328-5888 8 – 5 Mon – Fri
Minnesota 612-448-6987

hard that collecting, observing, or even laying out study plots is a challenge. Deer and elk, however, were seen in blowdown areas within days of the May 18 eruption, and they continue to make forays through the area. These large mammals have also been sighted in mountain basins just north of Spirit Lake, more than five miles from normal vegetation. When they find no food, they simply leave. If they do come across a patch of vegetation, the damage they cause by browsing can be traumatic for the plants and the creatures dependent on them.

America's cosmopolitan deer mouse occurs in a few blowdown sites. In some, where the Soil Conservation Service has attempted to stabilize the soil by seeding with grasses and forbs, high population densities have developed. Gophers, on the other hand, are on the decline in many places. These small mammals feed on bulbs and other belowground plant parts. The roots of such plants as bracken fern and fireweed, often the most conspicuous survivors, do not supply the necessary nutrition. Other, more suitable plants have not yet returned in great enough numbers to support gophers.

In the high-ashfall sites, insects and spiders are abundant and seem to represent a normal admixture, except for ground-dwelling forms. Small wolf spiders (Lycosidae) are common in high ashfall; other ground dwellers have not fared so well. Although in reduced numbers, the same species of small mammals, as well as plants and many other animal groups, occur in heavily ashed areas today as during preeruption times. Our pocket gopher data, for example, suggest population densities lower than at other places we have studied, and our marked population, lacking adequate food here as in blast and blowdown sites, may be declining slightly.

Birds are so mobile that their potential for reestablishment on the volcano is nearly unlimited. Some food exists, in the form of seeds and insects. In some areas, the reseeding projects have produced a considerable food supply for birds that can utilize grass seeds. Many of the bird species inhabiting Mount St. Helens' forests before the eruption, how-

Ladybird beetles probably did not survive the May 1980 eruption, but ladybugs were back on the mountain as early as the summer of 1980. Aphids, feeding on surviving fireweed, provided the beetles with food.

ever, were conifer-seed eaters or insectivorous. For these birds, food is less abundant. Nevertheless, on a given day, a few birds can be seen flying overhead almost anywhere on the volcano. In the crater itself, helicopter pilots have reported that hummingbirds have dive-bombed their orange flight suits and the ubiquitous red plastic markers of geologists and biologists.

Establishing that birds are breeding on a site is more difficult than just compiling a list of sightings. Hole-nesting species, which require tree snags, might be expected to do well in the blowdown zone—if they could find food. Similarly, ground-nesting species might not find the ash too much of a problem. We have noted rufous hummingbirds, a raven, and a sparrow hawk in our plots in the blowdown area, but the birds we have seen most often on our early morning censuses of these sites are Oregon juncos (ground nesters) and mountain bluebirds (hole nesters). In the high-ashfall area twenty miles northeast of the crater, we have found nests and eggs of the junco. For one such site, we estimated, in midsummer 1981, more than sixty birds per twenty-five acres, mostly Oregon juncos and robins but also orange-crowned warblers, pine siskins, blue grouse, three species of woodpecker, varied thrush, and Town-

David Falconer, West Stock

THE THRILL OF EUROPEAN ROADS. THE JOY OF EUROPEAN PRICES.

We'd like to suggest a more attractive location in which to pick up your BMW.

Europe. Where you can slalom over winding Alpine roads. And blur the scenery along high-speed German autobahns.

A purely extravagant notion?

Hardly. Acquiring a BMW in Europe can save you as much as $4,000. Enough to pay for your entire trip.

And since your local dealer arranges everything, your trip will not only seem expense-free but carefree as well.

For more information, send this coupon to BMW of North America, Marketing Services Department, Montvale, New Jersey 07645.

NAME
ADDRESS
NAT 5
CITY
STATE
ZIP

THE ULTIMATE DRIVING MACHINE.
BMW, MUNICH, GERMANY.

© 1981 BMW of North America, Inc. The BMW trademark and logo are registered trademarks of Bayerische Motoren Werke, A.G.

Send in for a touch of
Ireland
free

Our beautiful all color brochure will tempt you to get in touch with Ireland. So will our prices.

But what you'll find in Ireland is priceless. Warm, friendly people, lively pubs and theaters, beautiful scenery and the sound of Irish laughter. We've captured a sampling of Ireland's charms in our "A Touch of Ireland" brochure. Send for it and start planning on a touch of Ireland in your vacation life. Then call your travel agent.

THE IRISH POUND ONLY COSTS $1.60
That's 10% less than last year, 30% less than two years ago.

IRISH TOURIST BOARD
DT-21
590 Fifth Ave., Dept. D., NY, NY 10036
Please send me your free, 32-page color book, "A Touch of Ireland".

Name
Address
City State Zip
My travel agency is:

Ireland
1982

send's solitaire. The site had been clear-cut some time ago and planted with conifers, which are now about six feet tall and growing out of six inches of ash. A mature forest adjacent to the clear-cut area, also heavily ash covered, contained eleven species and about thirty birds per twenty-five acres. These species lists and densities are not out of line with expectation for similar sites unaffected by the volcano.

I have not spent much time studying aquatic habitats on the mountain. In September of 1980, I visited temporary ponds in Mosquito Meadow in the high-ashfall area. They contained salamander and toad larvae that were about to transform, as well as a garter snake. In May of 1981, these ponds were full of breeding salamanders of two species, the long-toed salamander (*Ambystoma macrodactylum*) and the northwestern salamander (*Ambystoma gracile*). Jim Seddell of the U.S. Forest Service Laboratory at Corvallis, Oregon, has been studying streams in the blast area and has, for some sites, lists of species similar to normal situations. Among the species are insects, fishes, the tailed frog (*Ascaphus truei*), and the Pacific giant salamander (*Dicamptodon ensatus*). Muskrats, trout, mink, and newts (*Taricha* sp.) have persisted in some lakes—for example, Ryan Lake, also in the blast zone.

In addition to determining what animals now reside on the mountain, and in what numbers, Doug Andersen and I are attempting to test some hypotheses about the role of animals in the process of ecosystem succession. Working in a clear-cut, high-ashfall site, we are particularly interested in the impact of small mammals and ants on plants and soil. Studies of succession in the subalpine habitats of Utah have generated some specific and some general hypotheses about the sequence of events following disturbance to the landscape. For example, animals, as dispersers of seeds and fungal spores, may influence the presence or absence of some plant species. Currently, I am also testing these hypotheses on sites altered during the process of strip mining. My assumption is that ecosystem recovery processes should be similar regardless of the disturbing agent—fire, grazing, clear-cutting, or mining—and that observing the processes in both managed and unmanaged situations should increase the ability to repair ecosystems effectively. When Mount St. Helens erupted, we recognized in the volcano a natural laboratory that might allow us to test some of our ideas, on a scale that no federal or private funding could underwrite and in areas much like the sites I was studying in Utah.

A final report of our findings would be premature, but the pocket gopher, our favorite beast, seems to be living up to our expectations. Gophers consume the underground portions of plants: bulbs, corms, roots, and rhizomes. In the winter, gophers fill snow tunnels with soil, and the melting snowpack discloses ribbons of disturbed soil on the ground and a disk of freshly overturned soil around the burrow openings. These very characteristics were the basis for our postulation that gophers might have a positive role in the reestablishment of ecosystems on Mount St. Helens. First, gophers were good candidates for being survivors. Assuming that, even in the blast area, heat from deposited materi-

Elk were among the first animals to return to Mount St. Helens. They can roam widely for forage, which is patchily available on the mountain.

John Marshall

For Mexico it was a period of incredible wealth. Even the mortar of the church was mixed with silver dust and red wine.

Like so many great works of art, La Valenciana church is a reflection of the times. Very prosperous times for 18th-century Guanajuato, when the hills above this mellow Mexican town yielded a fortune in silver and gold. A church was built. As opulent a structure as money could buy. Filled with treasures. Built with treasures. For the legend persists to this day that the mortar of La Valenciana was mixed with silver dust and Malaga wine.

Fortunately, the riches of Mexico no longer require a fortune to enjoy. From our sun-ripened resorts to our vibrant cities and ancient civilizations, Mexico is a country of beautiful discoveries. The vacation for all the senses... at a sensible price.

Around every corner,
a new world of value.

Guanajuato

See your ASTA Travel Agent
NH-5/82

Mexican Government
Tourism Office
9701 Wilshire Blvd./Suite 1201
Beverly Hills, CA 90212

Please send me your newest brochure "Mexico, The Amigo Country."

Name ____________________

Address ____________________

City ____________________

State __________ Zip __________

(Please print)

MEXICO
THE Amigo COUNTRY

Secretaria de Turismo · Consejo Nacional de Turismo

als was not too great, some of these fossorial animals might persist in otherwise barren landscapes, at least until they exhausted their belowground food resources. This has been the case, and we have found gophers in areas representing most types of damage, including blast, blowdown, and high-ashfall areas.

Second, we thought the soil-turning proclivities of gophers might be beneficial. If well-developed soil was trapped under volcanic material, the gophers, just like a plow, might turn over the fresh and inert ash material and mix it with the old soil. This is occurring, but at a slow rate because so many gophers have died since the eruption for lack of the right plants to eat. Where mixing is taking place, our prediction seems to be borne out. In the summer of 1981, soil turned over by gophers had more seedlings growing on it than did adjacent volcanic material not mixed by the animals.

There are many reasons why this might be the case. The buried soil contains more organic matter and various chemical nutrients than does the new material deposited by the eruption. The tilling activities of gophers might also make possible an important association that many higher plants form with a group of fungi known as mycorrhizae. This association may increase the plants' ability to get nutrients and water from the soil and may be critical to the survival of some species. Mycorrhizal spores are not as easily disseminated as those of other fungi. Several studies implicate small mammals, such as rodents and rabbits, and insects, such as grasshoppers, as dispersing agents.

Most well-developed soils contain the desirable mycorrhizae, but covered by ash, these soils might be ineffective. In an analogous situation—where topsoil stripped from coal mine sites is stored in large piles until mining is completed—mycorrhizae have been shown to decline with the time stored in the pile. The stored soil thus becomes an even poorer potential growth medium. On Mount St. Helens, the gophers' digging activities appear to rescue spores from the old soil and mix them into the ash material, increasing the ability of the mixture to act as a growth medium. In tests, samples of soil processed by gophers contain forty to eighty spores per gram of dry soil, while the adjacent volcanic material had an average of less than one spore per gram of dry soil.

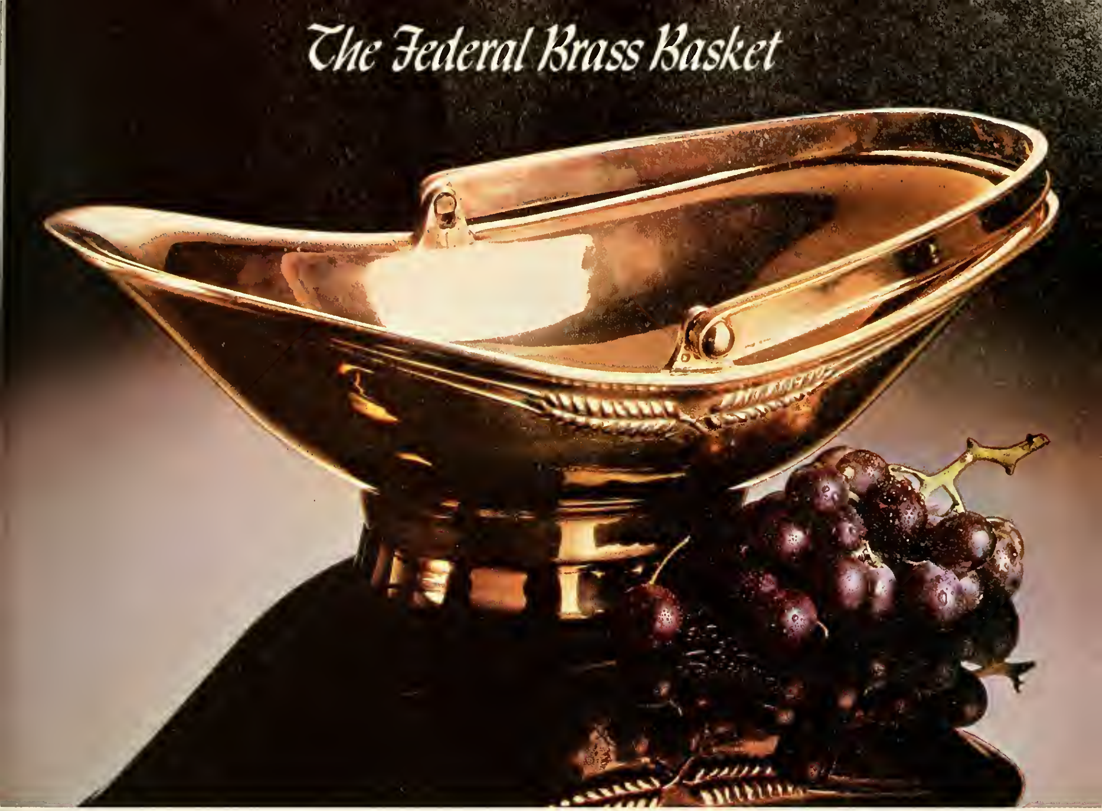
I do not mean to imply that gophers will be the main factor in the regeneration of the whole volcanically altered landscape, only that like all organisms, they have an influence, no matter how small. Mount St. Helens, recently reduced to a science fiction caricature of the surface of a planet, is very much a functioning, natural ecosystem in which the rules of the biosphere operate. Careful study of the varying abilities of different plants and animals to exist on the new Mount St. Helens is leading to insights on the varying roles these organisms have in the recovery of the volcano's ecosystems. Some of these insights, especially when combined with studies of undisturbed ecosystems, may help humans, users of various landscapes, approach management problems.

James A. MacMahon is a professor of biology and a member of the Ecology Center at Utah State University.

Bees, whose dense body hairs act as a trap for dust, were among the insects hardest hit by the abrasive ash. Populations of these beneficial insects, however, are recovering.

David Falconer

The Federal Brass Basket



Available in Limited Production. American Mastercraft™ from Phelps Dodge—1834.

IT IS 1799. THE DAWN OF THE FEDERAL PERIOD. THE TIME AMERICAN CRAFTSMEN DECLARED THEIR INDEPENDENCE FROM BRITISH COLONIAL INFLUENCE. NOW THEIR LEGACY CAN BE YOURS.

Rarely indeed has heavy solid brass been crafted so beautifully to attain such a graceful, airy look. Our basket is an achievement worthy of the Federal Period which inspired it. The time when the new nation established its own unique style of simple elegance. In bronze. In copper. And perhaps most beautifully…in brass.

The Federal Brass Basket is an ideal showcase for bread, fruit, and flowers. Its classic handle is ingeniously notched, so it can be nested on either side of the basket. Standing 4⁷⁄₈″ high and 13⁵⁄₁₆″ long, it weighs approximately 6 pounds, and is cast in solid brass—heavy American-made brass, considered the world's finest. And who better than Phelps Dodge craftsmen, with a proud tradition in copper and brass dating back to 1834, can so authentically evoke in brass the classic essence of the Federal Era.

EACH PIECE BEARS FOUNDRY MARK. The Basket is cast in limited quantities and struck with a distinguishing foundry mark. Each piece is individually hand finished to a rich deep glow that will mellow more beautifully year by year, with no two pieces exactly alike.

APPRAISE RISK FREE.

The Federal Brass Basket is not available in stores at this time. We can only guarantee to honor orders received before July 4, 1982. Priced affordably at $155, it will meet your every expectation. If not, you can return it within 30 days for a full refund. Use and enjoy your Federal Brass Basket just as our forefathers did their own beautiful brassware. And some day hand it down to your heirs—a brass heirloom of tomorrow. *Packaged suitable for gift giving.*

AMERICAN MASTERCRAFT FROM PHELPS DODGE—1834

To order, call toll free **1-800-228-2028**, Ext. 205.
In Nebraska, call **1-800-642-8300.** Or Mail Your Order:
American Mastercraft from Phelps Dodge—1834
P.O. Box 1350, Dept. K55, Bridgeport, CT 06601

Yes, please send me ____ Federal Brass Basket(s) at $155, postpaid including insured shipping. (CT residents add 7½% sales tax.) ☐ Check enclosed (payable to American Mastercraft) for total $________.

Naturally, your satisfaction is guaranteed—or return Basket(s) within 30 days for full refund of purchase price. Please allow 4 to 6 weeks for delivery.

Each piece bears the Phelps Dodge American Mastercraft 1834 foundry mark with center ring of copper set into the brass. Your guarantee of authenticity.

© 1982 Phelps Dodge Industries, Inc

Charge to ☐ VISA ☐ MasterCard ☐ American Express

Account No. Exp. Date Month Year

Signature

(Mrs., Mr., Ms.) Please print

Address

City State Zip

Give the gift that's perfect for any occasion

NATURAL HISTORY
$2
11/80
5/81

Send 12 beautiful and thought-provoking issues of Natural History to someone special. Natural History is the perfect gift for any time of year...a gift that keeps giving all year long. Your special someone will receive a membership card that will entitle him to all the benefits of Associate Membership in the American Museum of Natural History (see list at right). We'll send a handsome gift card to announce each gift. For only $15 per year, you can say so much for a birthday, anniversary, or any special occasion. Call the toll free number as listed below or use one of the postage-paid Natural History reply cards in the Magazine. Give the gift of Natural History today!

Your Gift brings all these Benefits:

- A one year subscription to Natural History (12 issues)
- Free admission to the American Museum of Natural History
- Access to the air-conditioned Members' Lounge
- Travel opportunities led by Museum scientists to all parts of the world
- Discounts on artwork, books, crafts, jewelry, and other gift items from our Museum shops and gift catalog
- Admission to special features and programs
- A valuable membership card
- Discounts on car rentals, other services
- Free ticket to our NatureMax Theatre

To Order: CALL TOLL FREE 800-247-5470
(In Iowa) 800-532-1272

Or Write: Natural History Magazine
Membership Services
Box 4300
Bergenfield, N.J. 07621

AMERICAN MUSEUM OF NATURAL HISTORY

A Preference for Sons

by Stanley A. Freed

The Endangered Sex, by Barbara D. Miller. *Cornell University Press, $17.50; 201 pp.*

The censuses that have been taken in India for more than a hundred years show a continuing sexual imbalance in North India: males outnumber females. In 1961, according to the last complete Indian census available to Barbara Miller, author of *The Endangered Sex,* the sex ratio (number of males per hundred females) for all of India was 106.3. This statistic is not especially startling, but there was considerable regional variation. For example, the sex ratio for the northern state of Punjab was 115.7, the highest in India.

Miller sets out to explain how and why there are fewer females than males in North India and then to suggest the way in which a more equal sex ratio could be achieved. The "how" part of her explanation is that the alleged neglect of female children, the modern successor to outright female infanticide during the nineteenth century, has produced the observed sexual imbalance. Miller claims that female children in North India are systematically deprived of food, medical attention, and love. According to her analysis, "why" female children are disfavored in the North "lies in the culturally mandated low demand for, and participation of, females in agricultural production there." Moreover, a daughter's wedding is a major expense that a North Indian family might prefer to avoid. It is "culture against females," declares Miller, shifting from science to social commentary and an insistence on social reform. There is, however, hope within this "picture of gloom." If culture rather than nature is the villain, then change is possible for, once understood, culture is humanly mutable. She is aware that the elimination of the cultural bases for the preference for sons would be "no small task," but she concludes her book with the observation, "Unless a concerted effort is made soon to counteract the forces promoting son preference, unless the victimization of North Indian daughters is slowed, then cultural sway will prevail, demanding the demise of fertility, of childbearing, of the female."

One of the principal problems with Miller's study is that it tries to do too much with too little. She attempts to draw conclusions applicable to all of India, a culturally and linguistically diverse country of about 684,000,000 persons, on the basis of relatively little information, much of it consisting of the brief, often impressionistic comments of a few ethnographers who were chiefly interested in subjects other than those that are crucial to Miller's study. The question of the extent to which particular observations about nutrition or love, for example, can be generalized is vexing since, in addition to regional variation, there are scores of populous castes, each with somewhat different customs.

Even if all her evidence is accepted uncritically and assumed to be generally characteristic of large parts of India, there remains the problem of whether the data adequately support Miller's inferences. For example, her efforts to document nutritional discrimination against girls in North India are based on somewhat conflicting impressions taken from a handful of ethnographies. Although some observers remark that boys are favored, others note no sex differences or that girls are favored. Moreover, it is not at all obvious that the noted differences are of such magnitude as to threaten life. "Similar food is given to males and females," according to one writer, "although boys who are in school may be given larger portions of butter." Another observer comments, "Boys are favored in terms of extras (snacks, sweets)." It would seem to be stretching the point to conclude from such evidence that North Indian girls are "targeted for death."

Miller's hypothesis that female children are disfavored in North India owing to the low level of female participation in agricultural production runs into trouble because her interpretation of the data appears to be questionable. Of those castes that she treats in detail, the Jats show the most strongly masculine juvenile sex ratio, and Miller judges the participation of Jat women in agriculture to be low, which would tend to support her hypothesis. In fact, Jat women work very hard in agriculture, as R.S. Freed and I observed during two years of residence in a North Indian village where the Jats were the principal agricultural caste. Not only Jat women but women of almost all castes work in the fields, as do boys and girls when not in school. People repeatedly told us that in villages where the Jats are the major landowners, "everyone works in the fields." It is difficult to understand how Miller received the contrary impression. She cites our work, among others, as evidence that Brahman and Jat women do relatively little work in the fields, whereas we state that they routinely participate in agricultural work.

The problem may partly involve a misunderstanding of differences in the practice of purdah, loosely defined as the seclusion of women. Among many Hindu castes, only married women are required to practice purdah, which usually means principally that their faces must be covered in public and before certain categories of men. Married women may otherwise move about the village and work in the fields.

Another part of the problem may be the definition of agricultural work. Miller discusses only cultivation and

GREAT ENTERTAINMENT,

A QPB softcover has all the virtues you expect from a bookstore hardcover. Durable binding. Full-size pages. Quality paper. Readable type.

But a QPB softcover costs up to 65% less than its hardcover counterpart.

So you get great entertainment in fiction, nonfiction, humor, how-to. But you don't pay a heavy cover charge.

Compare

DAVID ATTENBOROUGH
DAVID ATTENBOROUGH
Life on Earth
Life on Earth

Hardcover:	QPB Softcover:
$22.50	$9.95

421. Life on Earth: A Natural History. David Attenborough
Hardcover: $22.50 **QPB Ed: $9.95**

659. The Film Encyclopedia
Ephraim Katz
Hardcover: $29.95 **QPB: $11.95**

262. Solidarity: Poland in the Season of Its Passion. Lawrence Weschler
Hardcover: $16.50 **QPB: $6.95**

649. Maps of the Mind
Charles Hampden-Turner
Hardcover: $14.95 **QPB: $7.50**

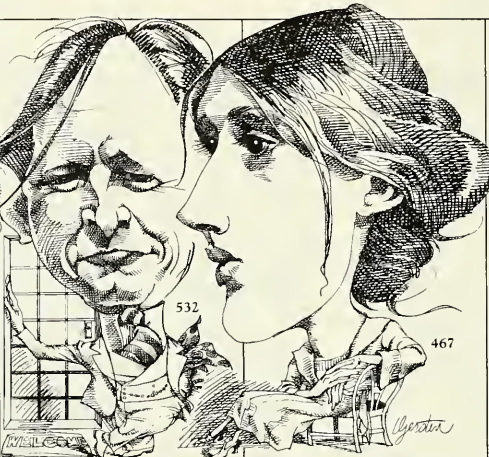
583. The Book of Revelations
Rob Swigart
Hardcover: $13.50 **QPB Ed: $6.95**

598. A History of Narrative Film
David A. Cook
Hardcover: $24.95 **QPB: $11.95**

614. The Woodwright's Shop
A Practical Guide to Traditional Woodcraft. Roy Underhill
Hardcover: $19.95 **QPB: $9.50**

617. The Gift of Good Land
Further Essays Cultural and Agricultural. Wendell Berry
Hardcover: $16.50 **QPB: $6.95**

618. Life in Darwin's Universe
Evolution and the Cosmos. Gene Bylinsky
Hardcover: $17.95 **QPB Ed: $8.95**



532. From Bauhaus to Our House
Tom Wolfe
Hardcover: $10.95 **QPB Ed: $5.95**

424. The Electronic Cottage
Everyday Living with Your Personal Computers in the 1980s. Joseph Deken
Hardcover: $14.95 **QPB Ed: $7.50**

545. Pioneer Women
Voices from the Kansas Frontier. Joanna L. Stratton. Introduction by Arthur M. Schlesinger, Jr.
Hardcover: $16.95 **QPB Ed: $7.95**

547. American Food: The Gastronomic Story (Second Edition). Evan Jones
Hardcover: $20.50 **QPB: $7.95**

573. The Country Gourmet Cookbook. Sherrill and Gil Roth
Hardcover: $14.95 **QPB: $7.95**

120. First Family Paper Doll & Cut-Out Book. Jim Fitzgerald and John Boswell. Illustrations by Al Kilgore. **QPB: $3.95**

462. Mathematical Magic Show and **Mathematical Circus** (2 Vols.)
Martin Gardner
Hardcover: $18.90 **QPB: $7.90**

464. Whitney's Star Finder
A Field Guide to the Heavens (Third Edition). **QPB: $7.95**

644. Pills That Don't Work. Sidney M. Wolfe, M.D., Christopher M. Coley and the Health Research Group. Hardcover: $15 **QPB: $5.95**

651. Mrs. Harris. Diana Trilling
Hardcover: $14.95 **QPB Ed: $7.95**

658. Pinball. Jerzy Kosinski
Hardcover: $14.95 **QPB: $6.50**

661. Washington Itself: An Informal Guide to the Capital of the United States. E.J. Applewhite
Hardcover: $15.50 **QPB: $7.95**

201. Waiting for the Barbarians
J.M. Coetzee. **QPB: $3.95**

295. After the Fact: The Art of Historical Detection. (2 Vols.) James West Davidson and Mark Hamilton Lytle. **QPB: $12.50**

115. Becoming a Writer
Dorothea Brande. **QPB: $4.95**

467. The Diary of Virginia Woolf
Volume One: 1915-1919. Volume Two: 1920-1924. Volume Three: 1925-1930. Edited by Anne Olivier Bell
Hardcover: $41.85 **QPB: $14.95**

518. The Sailor Who Fell From Grace with the Sea, Yukio Mishima; **Seven Japanese Tales,** Junichiro Tanizaki, and **Thousand Cranes,** Yasunari Kawabata (3 Vols.)
QPB: $12.95

286. A Book of Five Rings
Miyamoto Musashi
Translated by Victor Harris
Hardcover: $12.95 **QPB: $4.95**

660. Sounding. Hank Searls
Hardcover: $13.50 **QPB: $4.95**

334. Tassajara Cooking: A Vegetarian Cooking Book *and* **The Tassajara Bread Book.** (2 Vols.) (Illus.) Edward Espe Brown. **QPB: $8.90**

186. The Minds of Billy Milligan
Daniel Keyes
Hardcover: $15.50 **QPB Ed: $7.50**

596. The Solar Age Resource Book
Editors of 'Solar Age' magazine
QPB: $7.95

216. The State of the Language
Edited by Leonard Michaels and Christopher Ricks
Hardcover: $14.95 **QPB: $7.95**

657. Who Killed Karen Silkwood?
Howard Kohn
Hardcover: $16.95 **QPB: $7.95**

313. Zippy Stories. Bill Griffith
Introduction by B. Kliban
QPB: $6.95

647. How You Can Make $25,000 a Year with Your Camera (No Matter Where You Live). Larry Cribb
Hardcover: $14.95 **QPB: $7.95**

653. Watching TV: Four Decades of American Television. Harry Castleman and Walter J. Podrazik
Hardcover: $22.95 **QPB: $10.95**

646. Letters: A Novel. John Barth
Hardcover: $16.95 **QPB: $9.50**

233. King of the Confessors
Thomas Hoving
Hardcover: $16.95 **QPB Ed: $8.50**

181. The Chinese: Portrait of a People. John Fraser
Hardcover: $15.95 **QPB Ed: $9.95**

183. The Art of Picture Framing
Sherwood and Connie McCall
QPB: $7.95

112. Inversions: A Catalog of Calligraphic Cartwheels. Scott Kim
QPB: $7.95

200. The Art of Cooking for Two
Coralie Castle and Astrid Newton, and **One Pot Meals.** Margaret Gin
(2 Vols.) **QPB: $10.90**

229. Starting to Draw
Wendon Blake. **QPB: $5.95**

234. Five Economic Challenges
Robert L. Heilbroner and Lester C. Thurow
Hardcover: $10 **QPB Ed: $5.50**

257. The Comet Is Coming!
The Feverish Legacy of Mr. Halley. Nigel Calder
Hardcover: $12.95 **QPB Ed: $7.50**

108. Build Your Own Furniture
Peter Stamberg. **QPB: $7.95**

111. The Search for Alexander
An Exhibition. Contributions by Nicholas Yalouris, Manolis Andronikos, and Katerina Rhomiopoulou. (Photographs)
Hardcover: $24.95 **QPB: $9.95**

526. The Summer Stargazer
Astronomy for Absolute Beginners. Robert Claiborne
Hardcover: $7.95 **QPB: $3.95**

542. How to Be Your Own Doctor —Sometimes (Revised and Updated Edition). Keith W. Sehnert, M.D., with Howard Eisenberg. **QPB: $6.95**

151. The Lord of the Rings
(3 Vols., Boxed) J.R.R. Tolkien
Hardcover: $35.95 **QPB: $9.95**

163. Conceptual Blockbusting
A Guide to Better Ideas (Second Edition). James L. Adams
Hardcover: $10.95 **QPB: $3.95**

169. African Stories
Doris Lessing. **QPB: $8.50**

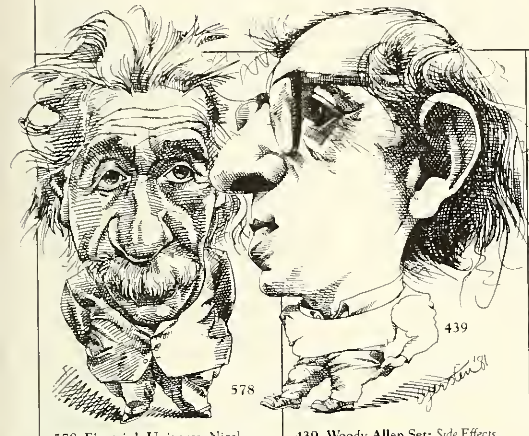
275. The Tokyo-Montana Express
Richard Brautigan
Hardcover: $10.95 **QPB Ed: $5.95**

279. Keep It Simple: 30-Minute Meals from Scratch. Marian Burros
Hardcover: $11.95 **QPB Ed: $6.95**

304. Finding Facts Fast: How to Find Out What You Want and Need to Know (Second Edition). Alden Todd
Hardcover: $7.95 **QPB: $3.95**

432. Celebrations of Life
René Dubos
Hardcover: $12.95 **QPB Ed: $6.95**

NO HEAVY COVER CHARGE



578. Einstein's Universe. Nigel Calder. Hardcover: $10 **QPB: $3.95**

386. Rapid Viz: A New Method for the Rapid Visualization of Ideas. Kurt Hanks and Larry Belliston **QPB: $6.50**

177. Let's Go: The Guide to Budget Travel in the USA 1982. Written by the Harvard Student Agencies, Inc. Edited by Peter S. P. Sanborn. **QPB: $5.95**

447. Myths of Greece and Rome Thomas Bulfinch. Compiled by Bryan Holme. **QPB: $8.95**

454. Brewer's Dictionary of Phrase & Fable. Centenary Edition, Revised. Edited by Ivor H. Evans Hardcover: $24.95 **QPB Ed: $12.95**

311. Madhur Jaffrey's World-of-the-East Vegetarian Cooking Madhur Jaffrey Hardcover: $17.95 **QPB: $8.50**

321. Ragtime. E. L. Doctorow Hardcover: $12.95 **QPB Ed: $4.50**

485. The Book of Laughter and Forgetting. Milan Kundera Hardcover: $9.95 **QPB: $4.95**

487. Reinhart's Women Thomas Berger Hardcover: $13.95 **QPB Ed: $6.95**

116. Information Please Almanac Atlas and Yearbook 1982. Hardcover: $9.95 **QPB: $4.95**

399. The Complete Directory to Prime Time Network TV Shows 1946-Present (Revised). Tim Brooks and Earle Marsh Hardcover: $25 **QPB: $10.95**

635. Drawing on the Right Side of the Brain: A Course in Enhancing Creativity and Artistic Confidence. Betty Edwards Hardcover: $13.95 **QPB: $6.95**

642. Selected Letters of James Thurber. Edited by Helen Thurber and Edward Weeks Hardcover: $15 **QPB Ed: $7.95**

477. Streisand: The Woman and the Legend. James Spada with Christopher Nickens Hardcover: $24.95 **QPB: $9.50**

278. Bread Upon the Waters Irwin Shaw Hardcover: $14.95 **QPB Ed: $7.95**

439. Woody Allen Set: *Side Effects, Without Feathers, Getting Even* (3 Vols., Boxed) Woody Allen Hardcover: $26.85 **QPB Ed: $10.95**

389. Sex in History. Reay Tannahill Hardcover: $17.95 **QPB: $7.95**

480. The Collected Stories of Eudora Welty Hardcover: $17.50 **QPB Ed: $8.95**

353. Lucy: The Beginnings of Humankind. Donald C. Johanson and Maitland A. Edey Hardcover: $17.95 **QPB: $7.95**

333. The Complete Catalogue of Mail-Order Kits. Anna Sequoia Hardcover: $14.95 **QPB: $7.95**

160. Camera Lucida: Reflections on Photography. Roland Barthes Translated by Richard Howard Hardcover: $10.95 **QPB Ed: $5.95**

414. The Life and Times of Joe McCarthy. Thomas C. Reeves Hardcover: $19.95 **QPB Ed: $9.95**

538. Brideshead Revisited Evelyn Waugh Hardcover: $9.95 **QPB: $4.95**

628. Garfield at Large and Garfield Gains Weight. (2 Vols.) Jim Davis **QPB: $7.90**

471. Shop New York by Mail A Print Project Book. **QPB: $6.95**

516. The Book of Rock Lists. Dave Marsh and Kevin Stein. **QPB: $7.95**

361. Futzie Nutzle's Modern Loafer Futzie Nutzle. **QPB: $4.95**

Let's try each other for 6 months.

Quality Paperback Book Club, Inc., Middletown, Pa. 17057. Please enroll me in QPB and send the 3 choices I've listed below. Bill me $3, plus shipping and handling charges. I understand that I am not required to buy another book. You will send me QPB *Review* (if my account is in good standing) for 6 months. If I have not bought and paid for at least 1 book in every six-month period, you may cancel my membership. A shipping and handling charge is added to each shipment. QB 113-5

Indicate by number the 3 books or sets you want ☐ ☐ ☐

2-16

Name________________________

(Please print clearly)

Address____________________ Apt.______

City____________ State______ Zip______

How membership works.
1. You receive **QPB Review** 15 times each year (about every 3½ weeks). Each issue reviews a new **Main Selection,** plus scores of Alternates. QPB books are softcover editions in hardcover sizes, but they cost up to 65% less.
2. If you want the **Main Selection** do nothing. It will be shipped to you automatically. If you want one or more Alternate books—or no book at all—indicate your decision on the Reply Form always enclosed and return it by the date specified.
3. **Bonus books for Bonus Points.** For each QPB book or set you take (except for the books in this offer), you earn Bonus Points which entitle you to choose any of our softcover books. You pay only shipping and handling charges.
4. **Return privilege.** If QPB *Review* is delayed and you receive the **Main Selection** without having had 10 days to notify us, you may return it for credit at our expense.
5. **Cancellations.** You may cancel membership at any time by notifying QPB. We may cancel your membership if you elect not to buy and pay for at least one book in every six-month period.

Prices generally higher in Canada.

643. Dun & Bradstreet's Guide to $Your Investments$™ 1982 (27th Edition). C. Colburn Hardy Hardcover: $15.95 **QPB: $7.95** *The title $Your Investments$ is a registered trademark of Harper & Row, Publishers, Inc.*

Join now. Pick any 3 books or sets for $1 each–with no obligation to buy another book.

134. Crowds and Power. Elias Canetti Hardcover: $17.50 **QPB: $7.95**

527. The Collected Poems Sylvia Plath. Edited by Ted Hughes Hardcover: $17.50 **QPB: $6.50**

397. The Unabridged Mark Twain, Vol. I. Edited by Lawrence Teacher **QPB: $8.95**

114. The Unabridged Mark Twain, Vol. II. Edited by Lawrence Teacher **QPB: $8.95**

605. On Writing Well: An Informal Guide to Writing Nonfiction (Second Edition). William Zinsser Hardcover: $9.95 **QPB: $4.95**

124. A Field Guide to American Architecture. Carole Rifkind Hardcover: $19.95 **QPB: $7.95**

474. The Big Book of Jewish Humor. Edited and annotated by William Novak and Moshe Waldoks Hardcover: $24.95 **QPB: $9.50**

252. White Horses. Alice Hoffman Hardcover: $12.95 **QPB Ed: $6.95**

QPB

The first book club for smart people who aren't rich.

does not deal with animal husbandry, a fundamental aspect of the rural economy. Women not only participate in cultivation but also in the care of animals, which except for grazing devolves almost entirely on them. The *Census of India* definition of work, which the author may have used, tends to denigrate the economic contribution of women and is inappropriate to her problem. An adult woman is said to work if she works for wages or produces things for sale. In the semisubsistence rural economy that involves the bulk of the Indian population, such a narrow definition ignores the fact, often commented on by appreciative Jat men, that women work very hard in agriculture as well as in the home.

Miller's concern with documenting the fatal neglect of girls in North India leads her largely to ignore problems posed by data that appear to favor the survival of girls. She presents graphs of the sex ratio by age of six important North Indian castes. In each case, the sex ratio increases (that is, the proportion of males grows) to reach a peak between seven and thirteen years; then each sex ratio declines (the proportion of males decreases), becoming more or less stable after twenty-three years of age. If the increasing sex ratio during some years is to be explained by the neglect of females, how is the declining sex ratio during other years to be explained? In all probability, the social and biological factors affecting sex ratios at various ages are so complex that to focus on one or two variables, such as nutrition, can be considered little more than the opening gambit in a difficult study.

If one keeps in mind the substantial weaknesses of Miller's data and interpretations, her book can be read with profit. She has assembled an impressive amount of scattered data and tried to make some sense of them in terms of an interesting and significant problem. Moreover, her procedure introduces two methodological improvements over other studies on Indian sex ratios. She deals with population statistics from districts (administrative divisions of states) rather than from states, and she systematically takes statistical differences among castes into account. In India as in the U.S., statistics from large regions with heterogenous populations are necessarily averages of figures from quite different subregions or social groups. Without more refined analysis, interpretations of such figures are difficult.

Aware of the limitations of her data, Miller shows sound judgment when, in evaluating her hypothesis concerning the relationship of female labor participation and juvenile sex ratios, she notes that her data are sparse, her interpretation of them open to question, and in any case, data from only half the social categories she has delineated support her hypothesis. My impression both from her book and from my experience in India is that the relatively high cost of a daughter's marriage and the security that sons often provide to elderly parents offer a better explanation of juvenile sex ratios than does female labor participation.

Although Miller prudently qualifies her scientific conclusions, she is rather unrestrained in her social commentary and demands for reform. Her indignation can hardly be based on her apocalyptic warning that something must be done to avoid the demise of the female and of fertility, for survival of the female is assured if for no other reason than men need wives, and fertility is in very good shape in India to judge from the population increase of about 135,000,000 persons in the decade 1971 to 1981. Rather she is probably bothered most of all by what she perceives to be a case of social inequality. She suggests that the government of India might decide to take remedial steps to educate people away from the preference for sons.

WHEN YOU WRITE TO NATURAL HISTORY

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance. You can use this form to tell us about a move or order a subscription.

Change of address—Attach your address label in the dotted area and fill in your new address below, clip and mail to Natural History Membership Services, P.O Box 4300, Bergenfield, N.J. 07621.

Cut your old address label from magazine
wrapper and attach over this area
Fill in your NEW address and mail to:
Natural History Magazine
Membership Services P.O. Box 4300
Bergenfield, N.J. 07621

PLEASE PRINT

Name ____

New Address ____

City ____ State ____ Zip ____

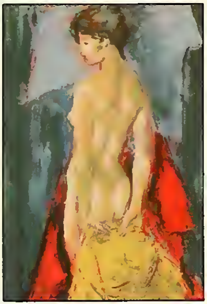
The bearing and raising of children are family matters. Indians take a rather different view of the family than do many contemporary Americans and therein lies the basis for significant misunderstanding. In India, the family is granted a great deal of autonomy; it is not too much of an exaggeration to say that the authority of the state stops at the door of the household, although there are indications of increasing governmental involvement. Rural Indians, especially, who constitute about 80 percent of the population, do not generally interfere in the affairs of other families and would not summon state agencies to do so, even when serious crimes against family members are involved. It is "family business," say the villagers, which means that it is the business of no one else, including the government.

The attitudes of many contemporary Americans are different. They stress the individual, not the family; independence and equality, not a hierarchy of intrafamilial authority and dependency relations; self-development and personal satisfaction, not obligations. Many influential Americans believe that the interests of the individual and the larger society are best served by increasing the role of the courts and various governmental agencies at the expense of family autonomy and responsibility. Indians believe that strong, responsible family life is vital to the social order.

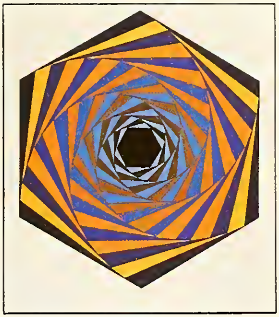
From the American perspective, Miller's ideas of social reform fit the times. She believes that she has spotted an inequality in Indian family life and that the government must take action to rectify it. Indians would not be so sure. Disproportionate sex ratios with more males than females in parts of the country are not likely to move them to take hasty steps. Moreover, they would hardly find American advice as to proper family life credible. They look at the American family with its high divorce rate, premarital pregnancies, illegitimacy, and abortions and want no part of it. They may know that their family life is not perfect, but it serves them well. Although Miller has pointed to an interesting problem, tampering with Indian family life to balance juvenile sex ratios would probably be ill-advised in the present very limited state of our knowledge.

Stanley A. Freed is a curator in the Department of Anthropology at the American Museum of Natural History.

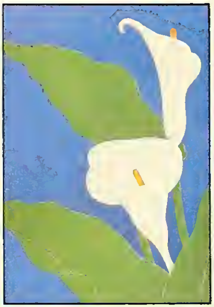
What your home could have in common with the Met, the Tate, and the Louvre.



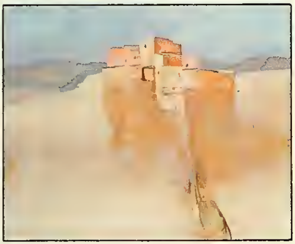
Jan de Ruth's *After the Bath*, original serigraph.
Signed limited edition of 250.



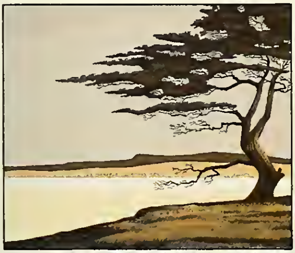
Victor Vasarely's *Los Angeles*, original serigraph.
Signed limited edition of 240.



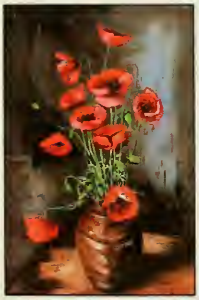
Fernando Torm's *Calla Lily*, original etching.
Signed limited edition of 195.



Claude Gaveau's *Les Bastides*, original lithograph.
Signed limited edition of 175.



Earl Klein's *Pacific Sentinel*, original serigraph.
Signed limited edition of 150.



Eric Peyrol's *Les Pavots*, original lithograph. Signed limited edition of 125.

In your own home, you can exhibit original work by artists who are represented in the world's great museums and galleries.

Artists like Calder. Chagall. Dali. Miró. Picasso. Vasarely.

At the Original Print Collectors Group, we offer moderately priced limited edition prints by these and other well-known artists.

Our offerings include signed original etchings, engravings, lithographs, woodcuts, and silkscreen prints.

Each print we offer is signed and numbered by the artist. Custom-framed. Accompanied by a certificate of authenticity and a full money-back guarantee.

And each print has been chosen not only for its beauty but for its investment value.

(Works by the artists we offer tend to appreciate, sometimes as much as 30% in a single-year. Perhaps that's why *The Wall Street Journal, Business Week, Money,* AP, *Barron's* and UPI have quoted us as an authority on investing art.)

For more information, send in the coupon. There's no obligation.

You'll find out about the special pleasure of owning original art, instead of just visiting it.

Visit our new gallery located at 215 Lexington Avenue,
Mon–Fri, 9–5 PM. Telephone: 212-685-9400 Ext: 35

Original print collectors group, Ltd.

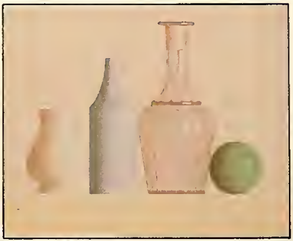
215 LEXINGTON AVE., DEPT. NH-39, NEW YORK 10016

PLEASE SEND ME YOUR FREE COLOR
CATALOGUE WITHOUT OBLIGATION.

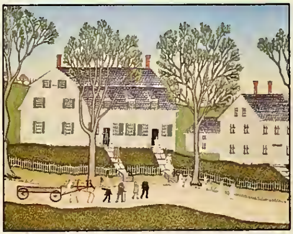
NAME ______________________
(PLEASE PRINT)

ADDRESS ______________________

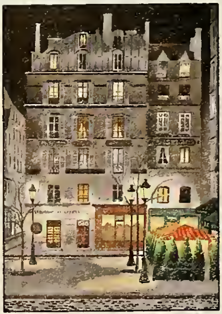
CITY ______________ ST ______ ZIP ______



Francois Vidalens' *La Boule Verte*, original lithograph.
Signed limited edition of 225.



Kathy Jakobsen's *Shaker Meeting House*, original lithograph.
Signed limited edition of 225.



Jean-Luc Lecoindre's *Montebello*, original lithograph. Signed limited edition of 125.

© 1982 OPCG, LTD

Jewelweed's Sexual Skills

For this annual, sex is sometimes showy and expensive, sometimes cautious and cheap

by Donald M. Waller

From late August through September, the pendent, red-flecked orange flowers of *Impatiens capensis* (*I. biflora* in older manuals) are a familiar sight, gracing streamsides and openings in flood-plain woods of the northeastern and midwestern United States. Rain and dew drops bead up on the light green leaves and sparkle in the sun, hence the common name jewelweed for this succulent-stemmed annual.

The flowers are distinctive, with one of the sepals forming an elongated sac that ends in a curved spur. Inside the spur, a copious supply of nectar awaits bumblebees and hawkmoths with tongues long enough to reach it. Patches of wild jewelweed are also visited by ruby-throated hummingbirds, which dart swiftly from flower to flower, matching the bumblebees' quick, direct movements. These birds, too, have tongues long enough to give them access to the nectar cache. Beige stripes of pollen appear on the backs of the insects or the forehead of the hummingbird. It is a light load, even for the small bee, but to the jewelweed it is all-important. The pretty blossom and its sweet nectar entice the mobile bees and birds into playing matchmaker for the sedentary jewelweeds.

To maximize their chances for spreading pollen to, and receiving pollen from, as many other plants as possible, these flowers have evolved another, less noticeable trait. When the flowers open, they function as males and their five anthers spread sticky pollen abundantly on any visitor. After about a day, however, the flowers drop the anther unit, exposing for the first time the virgin female receptive surface, the stigma. Because each flower progresses from an entirely male phase to an entirely female phase, self-fertilization is prevented and cross-fertilization with another flower enforced. Devices to prevent self-fertilization, such as this simple sequence of sex roles, are common throughout the plant kingdom. Noting these devices, Charles Darwin concluded that "nature abhors perpetual self-fertilization."

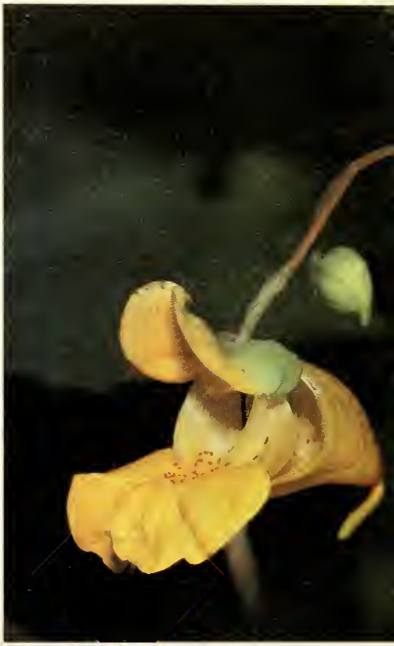
Larry West

In addition to these showy, distinctive flowers, jewelweed produces another kind, minute (one to two millimeters) and inconspicuous. Termed cleistogamous by botanists (Greek for "hidden marriage"), these tiny flowers never open to admit visitors, but instead always self-pollinate. Natural selection has reduced the number and size of their parts to a bare minimum: vestigial petals, no nectar, and only a few pollen grains. These flowers develop from a green, budlike stage directly into an enlarging seed capsule, which may still have its flower envelope attached to its tip like a cap. The cleistogamous flowers grow singly from the axils of leaves on lower branches. The bigger, brighter chasmogamous flowers (from *chasma*, "opening" in Greek) occur in clusters from axils near the top of the plant or the tips of branches. Individual plants usually produce both kinds of flowers, but the cleistogamous flowers are easily overlooked.

Why should a plant with one apparently effective means of producing seeds bother making another kind of flower? Why hasn't natural selection favored one mode of reproduction over the other? What and how great are the dangers posed by self-fertilization for a plant that habitually indulges in it? For the last several years I have striven to answer these questions.

Any effort to understand jewelweed's breeding system requires an understanding of its growth and reproduction. As its name implies, jewelweed is rather common and grows in a variety of habitats. Although most successful in clearings near streams or in marshes with consistently damp soil, jewelweed also manages to invade seasonally dry and sometimes sandy flood plains and even relatively dry and shady sites in some oak forests. Under ideal conditions—well-lighted sites that remain damp throughout the summer—jewelweed grows from a small seed (weighing less than a thousandth of an ounce) in March to a plant up to six feet tall by late August. The plant could not grow so quickly if it took time to construct a woody stem or even the dense pith of

John Richardson



Facing page: The showy flowers of Impatiens capensis, *known as jewelweed, hold their nectar in a long saclike sepal that terminates in a long, curved spur. To reach the nectar reward, a pollinator must have a long tongue. Above:* Impatiens pallida, *closely allied to jewelweed, has paler flowers and a stubbier sac. The shortness of the sac may make it easier for some bees to reach the nectar and, consequently, to accomplish pollination.*

Donald M. Waller

many other herbs; instead it builds a hollow, succulent stem, held erect by turgor pressure. In dry or shady locations, jewelweed only grows one to two feet tall and may succumb to a dry spell in July or August.

Despite the diverse weather and site conditions under which jewelweed grows, plants in any given population abandon vegetative growth and begin channeling their energies into flowers and seeds several weeks before they senesce, whenever this occurs. The species' ability to grow and reproduce in a variety of environments is crucial. As an annual without prolonged seed dormancy, jewelweed depends on regularly recurring seed crops to repopulate the stream banks and marsh edges each year. Any trait that insures that at least some seeds are set every year would be favored by natural selection.

Each chasmogamous flower that successfully attracts a pollen-loaded insect or bird develops into a translucent, pendent seed capsule containing three to five seeds. (The seed capsules that develop from cleistogamous flowers are similar except that they usually contain one to three seeds.) When fully ripe, the seeds darken and the capsule becomes sensitive and will burst suddenly at a touch, scattering the seeds. This trait has endeared jewelweed to many children (and not a few adults) who cannot resist the temptation to help the plant along by springing the capsules. It is also responsible for some of jewelweed's other common names, such as snapweed and touch-me-not, as well as its genus name, *Impatiens.*

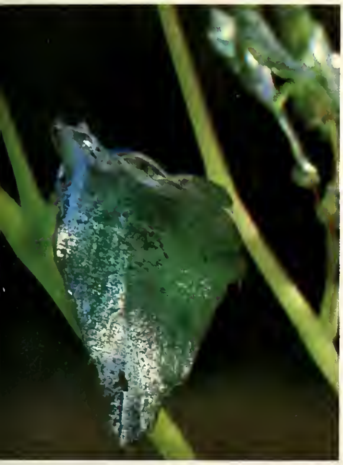
Once sprung, the seeds are shot up to five feet away. Since they also float, the seeds can disperse long distances down streams and around lakes. By having such capsules, jewelweed avoids having to bribe animal dispersers with fruits to carry seeds away from the parent plant. I have sometimes thought that the exploding habit might have arisen to foil predators. I once watched a finch peck repeatedly at ripe jewelweed capsules, only to have them explode in its face.

The production of both showy, outcrossing flowers and minute, self-fertilizing flowers is not unique to jewelweed nor is it universal in the genus *Impatiens.* The introduced garden species *Impatiens balsamina*, for example, rarely produces cleistogamous flowers. Other common plants that do have selfing flowers include wood sorrel, hog peanut, many violets, and the bush clovers. In some of these species, the same plant produces both kinds of flowers, while in others, individuals produce one kind or the other. In the eighteenth century, the Swedish systematist Carolus Linnaeus observed cleistogamous and chasmogamous flowers on species of *Cistus* (rockrose) and *Salvia* (sage). He further noted that when these plants were transplanted from their warm, native Spain to the colder climate of Sweden, they responded by producing only the closed, self-fertilizing flowers. Botanists since Linnaeus have observed similar responses to stress in many species capable of producing both kinds of flowers. The phenomenon is common enough to have been christened environmental cleistogamy.

The first scientist to give serious consideration to the puzzle posed by cleistogamous flowers was Charles Darwin. In his later years Darwin became especially interested in plant growth and reproduction. In *The Different Forms of Flowers on Plants of the Same Species* (1877), he discussed the incidence of cleistogamous flowers in many species and accurately described their structure. More than once Darwin remarked on how "wonderfully efficient" these flowers were in their economy of pollen and success at setting seed. He

Left: In addition to showy, outcrossing flowers, jewelweed produces tiny, self-pollinating flowers in the axils of branches. These flowers, here growing on a greenhouse plant, enable jewelweed to set seed even under conditions adverse to pollinators. Below: When submerged in water, the simple, toothed leaves take on a silvery sheen. This may explain another of Impatiens capensis*'s many common names—silverweed.*

Mark Warner



further noticed that in species with both cleistogamous and chasmogamous flowers, the chasmogamous flowers are usually medium to large in size and bilaterally symmetric, as in jewelweed. Such flowers effectively exclude many small generalized pollinators and must rely on specialized animal pollinators for fertilization. This, Darwin reasoned, would make the outcrossing flowers vulnerable to complete seed failure if harsh weather conditions or some other adverse event kept pollinators away. Selfing flowers could provide an alternative method of reproduction.

Cleistogamy is more common in annuals than in perennials, for which failure to set seed one season is not fatal. For species that frequently colonize new sites, selfing offers an additional advantage. If it is self-fertile, even a single seedling arriving at a new location can set some seeds and populate the site with its descendants. Thus the value of cleistogamous flowers is clear.

More difficult to understand is why plants don't always rely on self-fertilizing flowers. In attempting to answer this question, Darwin conducted some ten years of experiments, involving thousands of hand pollinations. He demonstrated that for several species of garden flowers (which normally outcrossed), the seedlings derived from continually self-pollinated lines were generally smaller than those resulting from cross-pollinations. (Remarkably, Darwin accomplished all this before the rediscovery of Mendel's laws of inheritance, which provide a genetic explanation for inbreeding depression.) Darwin suggested that cross-fertilization would normally be favored because it produced more vigorous offspring, but that under conditions adverse for pollination, species able to produce seed efficiently by means of specialized self-fertilizing flowers would be at an advantage. Most botanists still accept this explanation.

Does this explain jewelweed's pattern of flowering, too? To find out, I pursued several lines of investigation. At the outset, I thought it important to assess whether different environmental conditions affected jewelweed's breeding system in the same way that they affect species known to exhibit environmental cleistogamy.

I surveyed several natural populations growing in a variety of sites near Princeton, New Jersey. At each site, I took measurements of light intensity, soil moisture, and the proportion of outcrossing flowers. The populations displayed a simple pattern: those growing in areas with both sun and moist soil, such as in openings along streams, produced mostly outcrossing flowers; while those with either dry soil or shaded conditions produced fewer outcrossing flowers. One population growing in a pine plantation with very well-drained soil and continuous shade never produced any outcrossing flowers at all. Jewelweed's growth was so inhibited at this site that the seedlings never exceeded eight inches in height. These plants began to produce their selfing flowers in May before they had even dropped their embryonic leaves. This proved to be prophetic since the entire population died by early July, before any outcrossing flowers could have completed their development. Surprisingly, the seeds produced by cleistogamous flowers alone have been sufficient to maintain jewelweed at this site for years, and the population even appears to be expanding.

Next, I needed to evaluate how much of the variation in flowering was due to jewelweed's ability to respond to different conditions and how much was due to inherent genetic differences among the populations. I grew seedlings derived from a single population under different light and water treatments in a greenhouse. All of the plants devoted a similar fraction of their resources to self-fertilizing flowers. In contrast, as they became larger, the plants invested an increasing fraction in the outcrossed flowers. Sun-grown plants produced a great many outcrossing flowers, while shaded, smaller plants produced only a few. Plants that were both shaded and exposed to drought conditions hardly grew at all and never produced outcrossing flowers, just like the plants in the pine woods. Apparently, a threshold size must be exceeded before a jewelweed plant will invest in outcrossing flowers. Differences in plant size accounted for most—but not all—of the differences in flowering behavior. When I experimentally shaded one group of plants in the field while leaving an adjacent group of the same size exposed to partial sunlight, shading still reduced the number of outcrossing flowers produced.

I also wanted to determine exactly how much "cheaper" seeds produced by selfing flowers were compared with outcrossed seeds. The efficiency of these flowers had been evident to all who studied them, but no one had tried to measure precisely how many grams of plant tissue or calories of energy were saved by relying on modest, self-fertile flowers instead of showy, outcrossing flowers with their large corolla and abundant nectar.

To do this, I studied a population in a patch of woods on the Princeton campus that I could visit every other day. Although only a few acres, this patch of oak-hickory forest bordered a stream, which permitted a dense stand of jewelweed to grow. I carefully followed the survival and growth of a number of flowers of each type from their inception

Jewelweed puts forth outcrossing flowers most abundantly in areas with sun and moist soil. On a large, healthy plant, the tips of the flowering upper branches may have several buds waiting their turn.

John Richardson

as buds through the maturation of ripe seed capsules. The bulk of the outcrossing flowers were initiated in late August and took nearly five weeks to develop a mature capsule. Although most plants initiated a few selfing flowers early in midsummer, these rarely developed unless the plant was injured or suffered drought. Most of the cleistogamous flowers were produced late in the season, in September, after the outcrossing flowers. Since these flowers require only a little more than three weeks to mature seed, they provide a means for setting seed right up until the frosts of October. Clusters that initially contained only showy, outcrossing flowers even reverted to producing selfing flowers, occasionally passing through an intermediate flower type.

By averaging information gathered for more than seven hundred flowers, I could compute the overall probability of a flower of either type surviving from its inception to a ripe seed capsule. For both flower types this was between 50 and 60 percent. Flowers and developing capsules cropped from other, nearby plants provided estimates of how much plant material, or biomass, was invested in flowers or fruits at every stage of development. Using both these biomass figures and my calculations on survival from bud to seed, I then estimated the total production costs for a seed of each type. I found that seeds derived from selfing flowers cost only about two-thirds as much biomass as those from outcrossing flowers.

While I was busy doing these studies in New Jersey, Doug Schemske, now of the University of Chicago, was conducting a similar intensive study of several *Impatiens* populations in Illinois. By carefully tracking the development of the flowers, he discovered that the pollen-release phase lasts about twenty-four hours, while the receptive phase only lasts about four hours. He also found that larger plants invested a greater proportion of their resources in outcrossing flowers and seeds than smaller plants, and that sunlight enhanced this response. Using the currency of calories

Big, flashy outcrossing flowers are more expensive to produce than self-fertilizing ones. The benefit to the plant is sexual recombination and the possibility of superior seedlings. Cross-fertilization is assured in these flowers by a simple sequence of sex roles. In the first, male phase, the blossom sheds its pollen. Then it drops its male parts, exposing the female stigma.

Clyde H Smith; Peter Arnold, Inc.

and including nectar production, Schemske estimated that seeds from the cleistogamous flowers cost one-third to one-half as much as seeds from outcrossing flowers. I was gratified to have confirmation of jewelweed's plastic response and of the necessarily imprecise measurements of seed cost.

My greenhouse work with plants from one population suggests that much of the variation in outcrossing I observed between different jewelweed populations could be caused by plastic response to different environments. Since the investment in outcrossing, rather than selfing, flowers is what varies the most, environmental cleistogamy is really a misnomer for jewelweed. Small plants produce few or no outcrossing flowers, but other stresses can produce this response in larger plants as well. Whenever jewelweed was grazed by deer or when I cut off the ends of its branches in the greenhouse, seeds ripened only from selfing flowers. The response allows jewelweed to mature seeds quickly in the event of damage or drought. This kind of switch-hitter strategy must surely contribute to jewelweed's consistent reproductive success.

But why should large plants be more willing than small individuals (speaking teleologically) to pay the high costs of outcrossing? Darwin had demonstrated the superiority of outcrossed plants for several varieties of garden flowers. To determine whether some intrinsic advantage accrues to outcrossed jewelweed offspring, I measured germination and growth of both kinds of seedlings in the greenhouse. There was some superiority for the outcrossed seedlings as a group, but also considerable variability. Since greenhouse conditions do not correspond to growth conditions in nature, I am now comparing the two types of seedlings in field studies.

If there is some consistent benefit of outcrossing, does its cost vary in any predictable way with plant size? There do not appear to be any obvious conditions inimical to pollinators that would decrease the likelihood of a small plant setting seed from its outcrossing flowers. Even in sunlit populations with ample moisture, some small, suppressed individuals produce only the small selfing flowers. Could it be that only large plants can produce enough showy flowers in conspicuous locations to attract the birds and the bees? This seems unlikely. I have not been able to detect any preference among bumblebees for flowers in any particular location, although the placement of outcrossing flowers at the tips of branches could reflect pollinator preferences. The answer may have more to do with the risks of reproduction. Small plants, able to produce only a handful of flowers and seeds, risk not setting any seeds at all if they invest only in outcrossing flowers, which may not be pollinated. Large individuals, with their greater number of both types of flowers, are in a better position to gamble against the odds of no pollinators. For them, the payoff of superior seedlings is worth the risk of a few unpollinated flowers, especially since the seedlings will likely face keen competition the next year in such a favorable habitat.

With so much developmental and physiological flexibility in the face of changing conditions, has jewelweed ever adapted by genetic means to particular kinds of environments? This is an important evolutionary question since if some general purpose genotype performs well in all environments, continued genetic recombination by means of chasmogamy would have little effect. Presumably, some of the new genetic combinations produced by sexual outcrossing are even better adapted to particular site conditions or more resistant to predators and pathogens. In self-fertile species capable of some outcrossing, once a particularly adaptive genetic combination is generated from cross-fertilization, it can be reliably passed along by selfing.

In my greenhouse experiments, I had noticed that New Jersey seeds germinated sooner than seeds from Massachusetts or Wisconsin, suggesting some genetic differences. Robert Simpson, Mary Leck, and V. Thomas Parker of Rider College have now gone further by comparing six New Jersey populations grown together in the greenhouse. They found no genetically based differences in vegetative behavior, but considerable differences in flowering times, which tended to match those observed in the source populations. These inherited differences between the populations indicate that the populations have undergone independent selection, adapting, at least to some extent, to local sites.

Apparently, then, jewelweed has evolved the ability to react tactically in the short term, by means of plastic growth and reproduction, to unpredictable changes in its environment, while simultaneously adapting genetically to certain site conditions. By generating new genetic combinations, outcrossing—a conspicuously expensive reproductive strategy—plays an essential role in this process of adaptation. For jewelweed, as for most species of plants and animals, the benefits of insuring genetic diversity are worth the costs. ☐

David Overcash; Bruce Coleman, Inc.

Weavers of Wood

A small number of Haida Indian women help keep the fine art of Northwest Coast basketry alive

by Peter M. Knudtson

It was Raven, the Haida say, who created their ancestral home—the Queen Charlotte Islands, an archipelago off the coast of British Columbia. In a mythical time, when nothing existed in the world but an endless expanse of sky and a sea without shore, Raven took magical stones from a powerful being beneath the ocean and spit them from his beak. The fragments of rock grew to form a cluster of beautiful islands in the sea, each covered with magnificent forests of spruce and cedar trees. This same hero and trickster, Raven, later brought the Haida people gifts of daylight and fire and fresh water—and also the skill, some say, to weave the first Haida baskets.

Early Europeans arriving in the resource-rich Northwest Coast area found the Haida living on the archipelago, as well as on the southern end of Prince of Wales Island in Alaskan waters. Along with their Tlingit and Tsimshian neighbors, the Haida have long distinguished themselves in the realm of Northwest Coast Indian art. Haida culture has given birth to generations of master woodcarvers and painters and, in historic times, to talented argillite carvers and silversmiths. Traditionally these artists have been men, and today several have an international reputation. In contrast, the baskets produced by generations of Haida women have not been accorded the same artistic status, although they were recognized, in the words of anthropologist Erna Gunther, as "a fine utilitarian ware that was distinguished by the excellence of its craftsmanship." This reputation is shared with other Northwest Coast Indian peoples, including the adjacent Tlingit and Tsimshian. (Tlingit women also wove the famed Chilkat blankets of cedar bark and mountain goat hair, which have been compared to the finest ancient textiles of Peru and Mexico.)

In the absence of pottery making, basketry evolved into a complex craft that was a major component of Northwest Coast aboriginal art. Proficiency in basketry was demanded of each female as she matured within the matrilineal Haida society. Males might assist a basket weaver in some way, perhaps in the gathering of materials, but no Haida man would want to weave a basket. And no woman was allowed to use the totemic motifs of animals, humans, and spirits that adorned the carvings of Haida men.

A Haida basket is a tree transformed, as one realizes while watching a Haida weaver, deep within a shadowy coastal rain forest, straining at the end of a great ribbon of bark that she is pulling from the trunk of a tall western red cedar. A modern weaver does this by first making a horizontal cut at the base of the tree with her hatchet. Then with vigorous upward movements of her arms, she rips a broad strip of bark from the tree until it is far above her head. Once she has jerked the bark free from the tree, she uses a knife to peel away the light inner bark lining in long strips, which are tied into bundles. The weaver takes care to harvest only a limited quantity of cedar bark from any one tree, so that it will heal, and sometimes pauses to whisper a friendly assurance or greeting to the generous tree. After the inner bark has seasoned for one year, it is separated into narrow fibers suitable for weaving.

The finest and most admired examples of Haida basketry are those constructed from the slender roots of the Sitka spruce. Among the Haida, there may be no more than a dozen basket weavers alive today, scattered among villages and towns in southeastern Alaska, the Queen Charlotte Islands, and mainland British Columbia, who are expert at working with this material. Two of the most respected are master weaver Selina Peratrovich, born in 1889

Provincial Archives of British Columbia

A Haida Indian woman on one of the Queen Charlotte Islands weaves a basketry hat.

Facing page: In this painting, Carmen Quinto Plunkett, a Tlingit Indian woman who lives near Juneau, Alaska, wears a hat woven some years ago by Selina Peratrovich, a Haida basket weaver who is still active at the age of 93. Tlingit artist Raymond Peck painted the hat and also designed the cape with its crest of the Thunderbird clan. Plunkett, a woodcarver who works in both traditional and modern styles, made the cape.

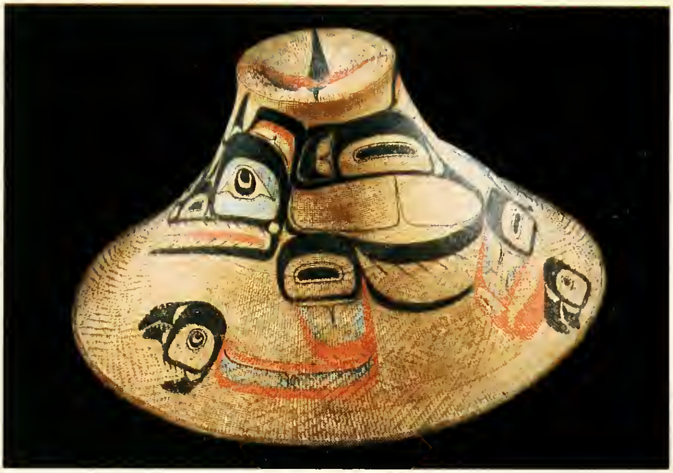
Tlingit, painted by Lunda Hoyle Gill. In a private collection. Photograph courtesy of Hammer Galleries, New York

A decaying totem pole in Ninstints village, an abandoned Haida site on one of the Queen Charlotte Islands, provides a backdrop for two spruce root baskets that typify the Haida art. The one at the left, made early in this century, is about six inches high; the other, about two inches taller, is possibly from the late nineteenth century. In comparison with the basketry of neighboring tribes, Haida work shows a preference for plain cylindrical forms, braided rims, and simple decorations that consist of variations in the woven pattern itself or of black rings created by the use of dyed weft strands.

Art Wolfe Collection of Dr Alan W. Lobb, Seattle

Among the masterpieces of Haida basketry are ceremonial hats, whose painted decorations were traditionally applied, not by the female weavers, but by men. This hat, which was woven before 1897, belonged to a woman who lived in Koona, a now uninhabited Haida village on one of the Queen Charlotte Islands. The painted decoration—the crest of a family lineage—represents a mountain goat.

Courtesy of the British Columbia Provincial Museum, Victoria



in the Queen Charlotte village of Masset, and her daughter Delores Churchill; both now live in the coastal town of Ketchikan, Alaska. As major native Alaskan artists, these two women have fostered a renewed interest in Haida basketry art among Haidas and non-Haidas by exhibiting their work, by serving as consultants to major museums, and by offering expert instruction to students. Recently, the two weavers were the subjects of a National Endowment of the Arts videotape study—another attempt to preserve the art.

In spring or early summer Haida women have for centuries ventured into the gray-green stands of spruce that embroider the sandy shorelines of the Queen Charlotte Islands to gather roots to make their baskets. Beneath the undergrowth of salal and thick moss, they would seek spruce roots of proper flexibility and dimension (no larger than one's little finger in diameter). Traditionally, they located such roots by digging a trench perpendicular to several roots with a fire-hardened digging stick. Today, garden tools and a pair of work gloves suffice.

In order to prepare them for weaving, coils of spruce root are carefully roasted on the embers of an outdoor fire. A length of root is lightly charred for a few minutes, then quickly uncoiled and threaded through a vertical slit in a wooden stake anchored in the ground. Pulling the root firmly through the slit removes the leathery bark by abrasion, leaving in hand a glistening aromatic cord the color of straw. Says Selina Peratrovich, "You put it in the fire—but not in the red coals. You steam it; then you take the skin off." For her, the root is sufficiently roasted when it begins to produce a distinctive hissing sound (her daughter insists, with a smile, that she has managed without ever having heard such a convenient cue).

Each root is then split, using a knife to start the cut (in the past, the sharp-edged shell of a mussel was the tool of choice). Gripped by fingers and teeth, the strands are then pulled apart. For a thick root, the woman lays several cuts in a manner that guarantees the piece will be fully utilized. The polished strips that formed the outer root are reserved for the most visible part of a basket; stout inner strips are employed for a basket's framework; the soft central pith is discarded.

The basic architecture of Northwest Coast baskets follows either of two primary designs. In a "coiled" basket, the foundation consists of a spiraling bundle of fibers, the coils of which are sewn together by loops of fiber. An awl or needle is used as a tool in the process. A "woven" basket, on the other hand, requires no sewing tool: a flexible fiber—the weft—is twisted in and out of a series of stationary fibers—the warp. The technique can be anything from a quickly executed "plain" weave, in which the alternating undulations of strands of similar width form a checkered pattern, to an elaborate braiding of multiple weft strands that creates rows of decorative texture.

The Haida traditionally produced only woven baskets. Checker techniques were employed largely for common household ware, especially vessels used for hauling and storing, usually made of cedar bark. Cedar bark also found its way into mats that served as bedding, rugs, or room dividers; into capes worn to shed the incessant coastal rains; and possibly before and certainly following European contact, into simple sails for some ocean-traveling Haida canoes. Twining—in which two or more weft strands are twisted around each other as they are woven into the warp—dominated Haida work, however, and represented its highest refinement. Tightly twined spruce root formed the typical Haida cylindrical storage basket, the covered trinket or trade basket, and the ceremonial dance hat.

The intricate variations of twining were cataloged in detail for Tlingit basketry in a classic 1903 publication by George T. Emmons, a naval lieutenant with a keen interest in Northwest Coast artifacts. Emmons wrote that the Haida shared many of the specialized weaving techniques employed by the Tlingit and that in Haida work generally, "the ordinary Tlingit weave in spruce-root obtains, although the ornamentation differs." Emmons lists five separate styles of twined weave, ranging from those that create a sievelike fabric to others that yield decorative surface textures. The Haida used the former, for instance, in their sturdy, undecorated openwork baskets for gathering razor

Florence Davidson, a well-known Haida basket weaver, collects cedar bark, one of the two traditional raw materials of her craft (spruce root is the other). She first makes a shallow, horizontal cut in a western red cedar, left, then pulls a long strip free from the tree, center. (A limited amount is taken so that the tree will survive.) She peels off the inner bark lining in strips, right. The bundles of inner bark will be seasoned for a year before being split into fibers suitable for weaving.

clams, edible seaweeds, and berries. The latter might be a rigid ropelike weave, made of three weft strands instead of the usual two, used to reinforce basket stress zones, such as the junction between bottom and wall or the perimeter of the lip.

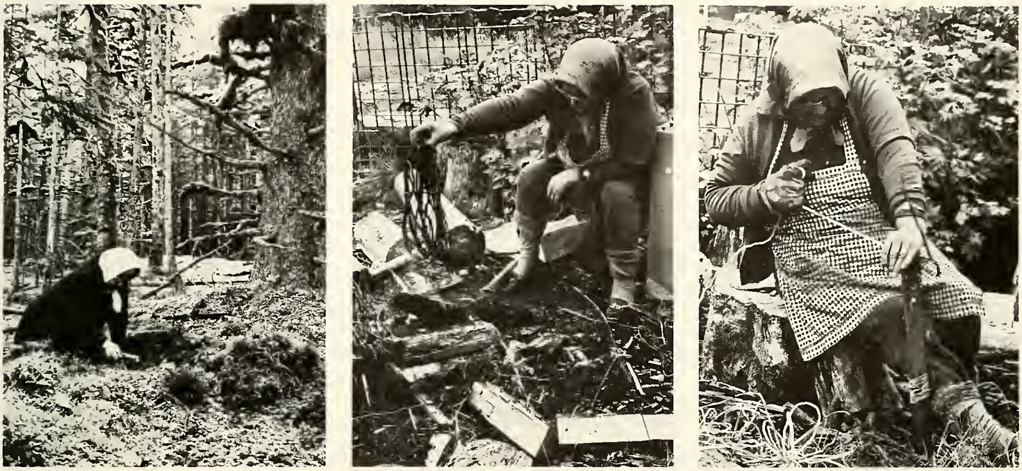
A Haida basket weaver begins her work with several warp fibers, which she bends and binds into a whorl; this basket "start," as it is called, is the embryonic base of the vessel and serves as a first scaffolding upon which two or more weft strands are twined. The bottom of the basket is completed first, then the work is inverted so that the weaving progresses from the base downward to the lip of the basket. This appears to be a distinctively Haida custom. Traditionally it was done by suspending the basket from an overhead cord; a modern weaver achieves the same result by tightly constructing the walls of her inverted basket over the frame of an empty bottle or can.

The strands of fiber are soaked before being used. Using moistened thumb and forefinger, and a simple weight to anchor the start at first, the weaver performs the basic twined weave by enclosing, in turn, each of the radiating stationary rays of warp with a pair of weft strands, crossing the latter between warps. By pressing each row of spiraling weft snugly against the preceding one, the weaver produces the beaded, vertically ridged texture typical of so many Northwest Coast spruce root baskets.

Additional lengths of spruce root are spliced into place, as extensions to the first warp fibers, by the encircling weaves of weft, so that the basket skeleton actually grows with the piece. Like a potter at a wheel, the Haida weaver can effectively shape her emerging vessel by varying the number of warp rays as she weaves: by increasing their number, she gives her basket an outward flare; by reducing their number, she pulls the shape in; by bending all the warp rays at a right angle, she achieves a transition from basket base to basket wall. The Haida basket weaver concludes her piece with one of several possible border weaves in the final rows of weft, anchoring and reinforcing the exposed edge of the basket vessel. In its simplest form, found especially in decorative ware, a border weave is nothing more than a last spiral of twined weave, following which the end of the weft is secured with a terminal knot and the protruding warp strands are trimmed. In other cases, the Haida might employ the more sophisticated three-strand twining, at which they are so adept.

Haida baskets are characterized, in part, by the simplicity of their ornamentation, often nothing more than the patterns of raised ridges created by a colorless decorative weave or by the simple substitution of a colored weft strand for the usual undyed one. When color did appear in the Haida basket, it was traditionally the stark black of local muds. Other, subdued hues—the pale yellow of a lichen, the green of copper ore, the reds and purples of berries and barks—also were eventually used. In historic times, Haida weavers began to decorate with a colored fiber wrapped around the outside loops of weft, an overlay technique called false embroidery, of which the Tlingit were masters.

According to Delores Churchill, the Haida had a repertoire of named basketry designs, as did their Tlingit neighbors. Often the names referred to natural objects or processes that, to the non-Haida, only remotely correspond to their geometric form; today the meaning of some names has even been entirely lost. Delores Churchill lists several "very old" Haida basket designs, among them, "fish bone," "cresting wave," and "spider web."



To obtain spruce root, Florence Davidson digs through the moss at the base of a Sitka spruce and removes slender roots, left. Coils of these roots are roasted over an outdoor fire, center, to facilitate removal of the bark. The roots are skinned, right, by pulling them through a slit board. Depending on its thickness, each root will then be pulled apart into two or more strands for weaving. Davidson, who lives in the old village of Masset on one of the Queen Charlotte Islands, was nearly eighty when these pictures were taken in 1976. She is the daughter of Charles Edenshaw, a famous Haida woodcarver, and the grandmother of Robert Davidson, a prominent contemporary carver.

Ulli Steltzer, *Indian Artists at Work*, published by J.J. Douglas, Vancouver

The Haida basketry hat—an elaborate broad-brimmed headpiece constructed entirely of spruce root—is the most elegant example of Haida fiber art. With a crown sometimes woven with variations of the three-twined weave, with a brim woven in the basic twined weave—punctuated with embossed diamond, diagonal, or zigzag patterns produced with special weaves—and with woven internal headbands to assure proper fit, the Haida spruce root hat was a feat of fiber engineering. Although other Northwest Coast peoples made similar hats, the Haida product came to be highly valued by neighboring tribes as an item of trade. Such a hat produced today can often command a price of $1,000 or more for the weaver.

The most beautiful Haida hats were the prized possessions of the traditional upper caste of Haida society and often bore distinctive cylindrical ornaments (woven over cedar wood forms) atop their crowns that announced the number of potlatches that had been given by their wearers. Delores Churchill believes such a hat could even serve as a binding legal document, effectively committing its owner to carry out the wealth display feast that it had so boldly already recorded. She has made the interesting observation that the bold horizontal black bands that decorate so many old Haida baskets—particularly the common, large cylindrical utilitarian ware—may have represented, like the ornaments on top of the Haida spruce root ceremonial hat, the number of potlatches that had been given by the individual who owned the baskets. The ceremonial spruce root hat also provided an interesting exception to the general rule of basketry decoration: it was often painted with the same totemic animal figures, often in conventional reds and blacks, that distinguished Haida wood art and two-dimensional drawings. This colorful adornment was customarily painted, not surprisingly, by a Haida male.

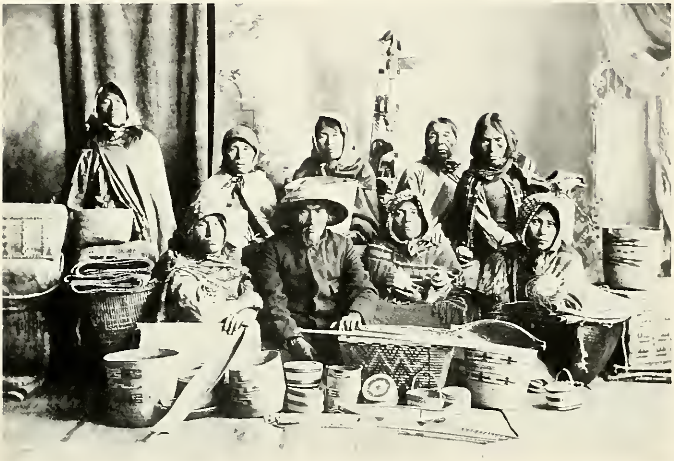
The features that distinguish Haida basketry from the work of neighboring peoples are not always clear to us today. In the first place, the Haida were active travelers and traders, and often intermarried with members of other cultural groups nearby. So basket-weaving techniques—in the form of objects of trade and the skills of new wives—inevitably diffused across ethnic boundaries. Add to this the sometimes questionable identification of Northwest Coast baskets by collectors lacking professional training (or perhaps unaware that a basket could surface in a place quite distant from its cultural origins), and any rigid system of classification of Haida basketry becomes even more elusive.

In an effort to resolve this uncertainty, anthropologist Joan M. Jones undertook a computer analysis of nearly three thousand identified Northwest Coast baskets from museums all over North America. Despite the artificiality imposed by such a statistical study of somewhat arbitrary design elements, several diagnostic trends were identified in most Haida baskets. Among them were the frequent use of cylindrical basket shapes, braided rims, and relatively plain basket exteriors that reflected a preference for ornamentation created by the primary weft weave itself, rather than by secondary overlay of colored strands. Furthermore, Haida basketry during the past two centuries has been relatively conservative, catering less to the commercial whims of the European buyer than did the wares of aboriginal neighbors. In addition to simplicity of design, Haida baskets generally show a preference for robustness: "The Tlingit did finer basketry," states Delores Churchill, "Haida baskets were usually made to be *used*." This she attributes, in part, *This portrait of Delores Churchill, a contemporary Haida basket weaver, shows her wearing a button blanket with an Eagle clan motif. The basket she is weaving incorporates designs of four Indian tribes—the Tsimshian, Tlingit, Nootka, and Haida. Churchill and her mother, Selina Peratrovich, are actively engaged in preserving and expanding their understanding of Haida basketry traditions and in communicating their knowledge and skills to young students and scholars.*

Haida Basketmaker, painted by Lunda Hoyle Gill. Collection of Mr. Homer Noble. Photograph courtesy of Hammer Galleries, New York

Baskets and mats made by a number of Northwest Coast tribes, including the Tlingit, Nootka, and Thompson, surround a group of Indians in this studio photograph taken at the turn of the century.

AMNH



to the greater isolation enjoyed by the offshore Haida.

According to Bill Holm, curator of Northwest Coast Art at the Thomas Burke Memorial Washington State Museum, Seattle, the clearest distinguishing feature of Haida basketry is the direction of the steplike shifts that appear wherever there is a change in a basket's weave or color. These steps contrast with those found in baskets made by neighboring peoples and are simply a consequence of the Haida custom of inverting the basket as it is being woven. Holm states that the occurrence of this "Haida jog," as he terms it, is consistent with the other characteristics of Haida ware that have been observed, such as the black bands, three-strand weaving on the rim, and cylindrical form.

Haida basketry and other native arts were changed forever with the arrival of the first European visitors to the Queen Charlotte Islands. The Spaniards reached the archipelago by 1774 and found a population of some 8,000 Haida living a traditional way of life. Wave after wave of other Europeans followed, hungry for sea otter pelts and salmon, "heathen" souls and valuable minerals, and, today, virgin timber. These outside influences transformed, of course, far more than the arts of the Haida people: the foreign economy shattered the fragile surpluses that were the basis of the Haida potlatch ceremony, the mainstay of wealth and social status in Haida society (an 1884 Canadian law actually outlawed the potlatch); residential missionary schools took over the education of Haida children from family and phratry; new diseases, such as smallpox, ravaged the Haida in a series of epidemics; and alcoholism became a social problem whose effects linger today.

Pans of brass and tin, pewter basins, and textiles appeared in the homes of Haida basket weavers, displacing forever the tediously built utilitarian basket ware. And in exchange, Haida weavers turned to styles of Haida basketry that, serving as showpieces of the fiber artist's virtuosity, would command the highest export price. Although to a lesser extent than their Tlingit counterparts, Haida basket makers began to incorporate decorations that copied Christian symbols and European textile patterns, and occasionally to weave shapes—Communion goblets, cigar pouches, even tea kettles—that would please the foreign buyer and bring cash into the Haida home. The new trade baskets were fundamentally derived from the old, their shapes often elaborations of rounded traditional forms, their decorations—although supplemented with a new spectrum of synthetic colors and borrowed techniques of overlay—often rooted in the standard array of Haida twined weaves. But some traditional styles, such as the sturdy, undecorated spruce root and cedar bark ware that had dominated Haida basketry, approached extinction. By 1910, according to Erna Gunther, virtually no baskets were being constructed for use in Haida homes.

Today Haida basketry is enjoying a certain renaissance, including a renewed interest in the full range of its aboriginal forms. The recognition that older weavers are beginning to receive may encourage the recruitment of younger Haida to the art, reopening channels of communication through which Haida cultural values can be passed. Selina Peratrovich, in her nineties, tells an old story of the first Haida basket, a story that stresses the qualities of generosity and loyalty to kin that are still vital in Haida culture. It tells of a time, long ago, when the Haida did not have enough food to eat, and of a stern Haida woman who scratched her daughter's face for eating more than her rationed share of food. The young girl fled with her older sister to a beautiful place by a lake, where they encountered, in the form of a man, a Haida spirit helper. Seeing their distress, he instructed them to "pull up spruce roots, split them, and weave them around your thumb" to make a basket; in it, they were told to place one of each kind of food that grew abundantly nearby. Magically, the basket began to grow—along with its bounty of food—and the two girls returned to their village where they were greeted with great joy. The two girls went from house to house to share their precious basket of food with their neighbors, arriving last at the home of their mother. She too was given a gift of food, but died at once of shame as she received it from the daughter she had punished so severely. ☐

ex-cité

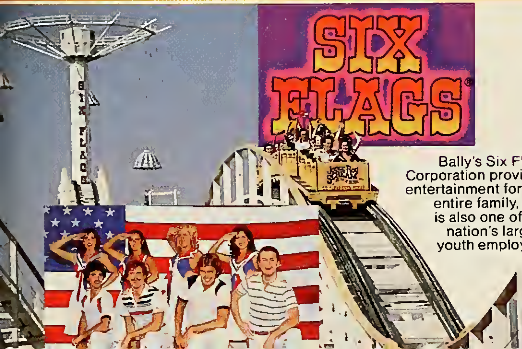
(Something that

In a world where many people's lives are all too routine, moments of true excitement are an essential part of a healthy lifestyle. Providing those moments is Bally's business. A leader in many facets of the amusements industry, Bally makes playful excitement available conveniently and inexpensively through family amuse-ment centers and family amusement restaurants, theme parks, and electronic video games. By entering into an exciting world of fantasy for a few minutes or a few hours, families can gain the immeasurable benefits of a brief 'vacation' from the routine that is an inevitable part of life in the modern world.

And young people enjoying the excitement of video games can gain a first glimpse into the world of micro-computers, a career field with boundless opportunities.

-ment
excites or arouses)

©BALLY, 1982



Bally's Six Flags Corporation provides entertainment for the entire family, and is also one of the nation's largest youth employers.

Today, more than ever, moments of escape into a world of fun and excitement are an essential part of the good life.

And those moments are the heart of Bally's business.

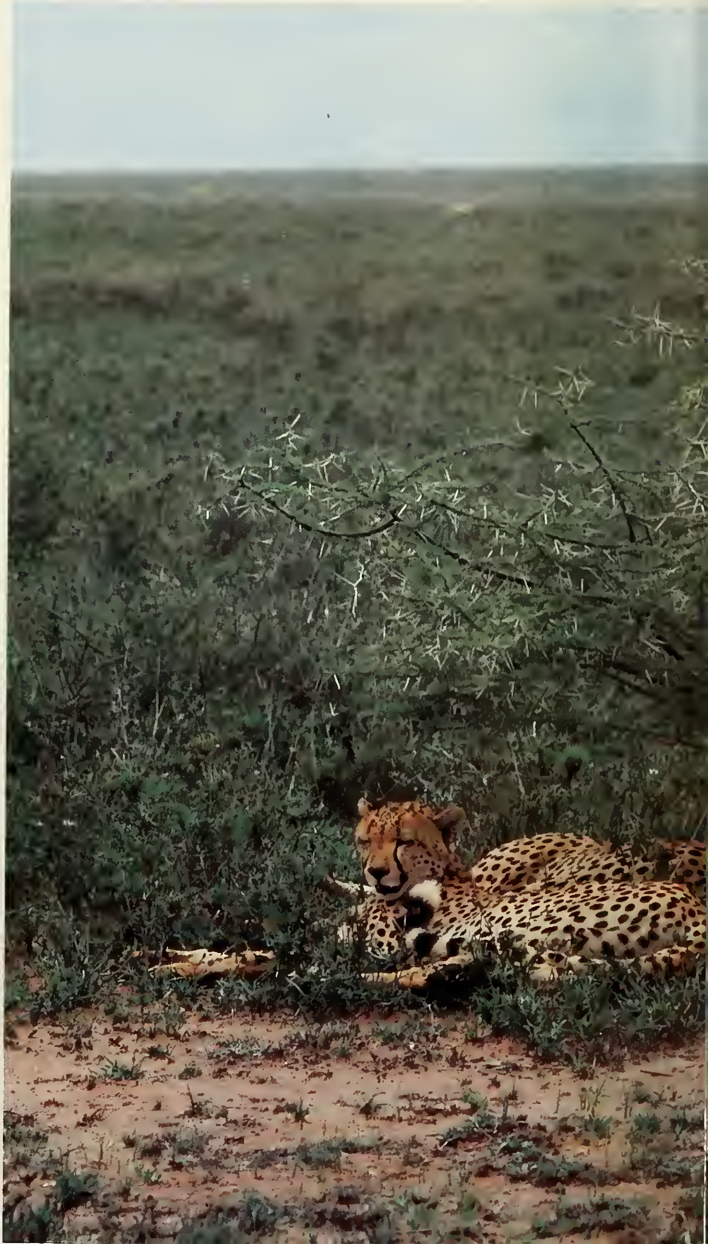
Fun is our business

Bally®

Life on the Cheetah Circuit

Tourists flock to Africa to catch a glimpse of this rare big cat. Their success depends on a cheetah's willingness to stay on stage

by David A. Burney



On an East African plain, two minibuses, loaded with tourists and camera equipment, approach a family of cheetahs resting in the ragged shade of a thorn tree. Moments later, two more vehicles arrive; their passengers join the chorus of clicking cameras and exclamations in various languages. The rare and elegant speed champions of the animal world beat an undignified retreat into the nearby bushes.

Six miles away, outside the boundary of the Masai Mara National Reserve in southwestern Kenya, a group of well-armed Masai herdsmen are slowly moving their cattle toward a distant settlement in the hills. The men sing and whistle as they unknowingly drive the herd straight toward another cheetah family crouched in a patch of tall grass. Undetected by the Masai, the cheetahs flee for cover.

Are human activities chasing these endangered cats to extinction? Some wildlife experts believe that even in and around Africa's national parks and game reserves human activity is adversely affecting the cheetah and other endangered animals. To determine whether this is the case, my wife, Lida, and I spent seventeen months investigating the effects of such activity on cheetahs in Kenya's Mara region. We were able to compare many aspects of cheetah behavior and ecology in various areas affected by human disturbance. We observed cheetahs as they encountered tourist vehicles, professional filmmakers, Masai tribesmen, park service personnel, and would-be poachers. For comparison, we spent hundreds of hours unobtrusively watching the same cheetahs when these disturbances were not present.

In the Mara region, the vast grass-

A female and her nearly grown cubs find respite from the midday sun in the scant shade of a thorny bush. Cheetahs can usually rest undisturbed during the hottest part of the day because tourists also avoid the scorching heat.

George W Frame

Two young cheetahs peer into the interior of a Land-Rover. Such habituation to machines is a sign of "polite" cheetahs, a term used by safari operators for individuals that don't flee from approaching tourist vehicles.

George W. Frame

lands of the northern part of the Serengeti ecosystem are subjected to two principal land uses: as a game reserve and as a rangeland for livestock. The 580-square-mile Mara reserve attracts about 45,000 tourists per year. These visitors tour the area by motor vehicle, viewing one of the world's greatest wildlife spectacles. Reserves and parks help make tourism Kenya's second largest industry. Surrounding the Mara reserve on three sides are more than 1,160 square miles of similar habitat, which supports Masai tribesmen and their livestock, as well as wildlife and some tourism. South of the reserve lies the much larger Serengeti National Park of Tanzania and two wildlife management areas. The cheetahs move freely between the reserves and "Masailand," as the Mara region is generally known.

Although the cheetah is one of the most sought-after creatures in the Mara, the wily cats often escape detection by tourists and their guides. The cheetahs' spotted coat and concealment behaviors often enable them to be virtually invisible or to disappear suddenly when they have had enough of tourists. More than 500 tourist vehicles passed within 800 feet of cheetahs we were observing from a distance, but about one-third of the groups never discovered the cats.

Cheetahs' responses to tourist vehicles are variable. Some individuals are much more tolerant of approaching cars than others. Drivers who approached with care were usually rewarded by being able to observe the cheetahs at length. Cars moving toward cheetahs in a slow, indirect fashion were usually able to avoid frightening them away. Cars moving quickly and directly to the cheetahs were much less successful. Cheetahs (and most other animals as well) react nervously when a large number of cars form a circle around them. People getting out of cars caused a reaction in the cheetahs even at surprisingly long distances—650 feet or more. When tourists got out of a vehicle near cheetahs (to the consternation of their guides), the cheetahs usually moved away quickly. Camera noises, soft talking, and quiet movement inside the car almost never had a visible effect. In general, patient drivers and cooperative observers were rewarded by a tolerant response from the cheetah.

Certain familiar cheetahs were remarkably tame and easy to approach, but others earned from us such nick-

While taking a drink, this mother makes sure that her cubs are close at hand. Lions, leopards, and hyenas often kill young cheetahs.

George W Frame

Vultures wait their turn as an adult male cheetah makes a meal of a zebra foal. Cheetahs are often driven off a carcass by other carnivores.

names as "the Phantom." This male fled every approaching vehicle before it came within 300 feet. A female that we called Polly was an extreme case of the opposite sort. Hundreds of tourists see and photograph her each year. Professional safari drivers in the area refer to cheetahs like her as "polite." (Cheetahs like the Phantom are said to be "cowardly." We prefer referring to the latter type as shy.) Even noisy, rapidly driven cars often lurched up to within fifteen feet of Polly without provoking her to flee. She has been the star of several wildlife movies in Europe, and has modeled for some of the best-known wildlife photographers in the world. While we were conducting our study, one cinematographer even filmed her giving birth to a litter of five cubs.

A cheetah's hunting success might be adversely affected if it has to spend much time and energy escaping tourists. This is probably true for cheetahs like the Phantom, but we were surprised to find that hunting success was slightly higher for car-tolerant cheetahs when the cars were present. They often appeared to use cars as a screen in order to approach gazelle, impala, and other fa-

George W. Frame and Lory Frame

George W Frame

At an airfield in Serengeti National Park, Tanzania, a cheetah uses a boarding ramp as a vantage point to search for prey.

vored prey in open country. Arriving cars also served to distract prey that had been maintaining a safe distance from a hungry cat. Tourist vehicles seldom drive polite cheetahs off a kill before they are nearly finished eating. In one instance we did see a rather shy cheetah driven off a kill by an approaching vehicle, and a hyena immediately appropriated the carcass. This incident was another demonstration that a tolerance of tourism may have survival value (in this case, for the hyena).

Although a single encounter with a vehicle is seldom a major disruption for a cheetah, the cumulative effect from a succession of vehicles is potentially more serious. Shy cheetahs would sometimes be chased by one car after another; at times twenty or more cars would be involved over an entire morning or afternoon period. Two shy male cheetahs that were hunting in the reserve just after dawn were three miles away by noon, hiding in thick cover outside the reserve. In parks such as Amboseli National Park in Kenya, where the density of tourist vehicles is several times as great as in most parts of the Mara, cheetahs may be disturbed so frequently that their hunting or other important behaviors are disrupted. Researchers working in this heavily visited park have suggested that this may be the case.

Some shy cheetahs gradually learn to tolerate vehicles. Our observations of professional photographers at work with cheetahs showed this clearly. Two cheetah families that we spent hundreds of hours studying were also the stars of wildlife motion pictures. Several professional cinematographers filmed them periodically throughout their development. To make such a film, the photographer must spend many hours close to the subjects (but inside a vehicle). As the days, months, and hundreds of feet of film rolled by, the cheetahs gradually changed from shy phantoms to exceedingly polite animals that even made occasional contact with stationary cars.

Although they are usually careful to minimize their impact, photographers and other wildlife observers who stay with cheetahs for long periods mark the location of the animals. The result is that other vehicles are attracted to the spot and the cheetahs may be chased out of the area. To avoid attracting tourists to cheetahs, some filmmakers work primarily in Masailand, where tourists are scarcer.

We were also interested in the interactions between cheetahs and Masai tribesmen outside the reserve. We recorded and analyzed seventy-six encounters between Masai on foot and cheetahs. Compared with the tourist data, there were some remarkable differences. In all cases, both cheetahs that tolerated cars and those that did not fled the Masai tribesmen at 300 feet or more. The cheetahs do well to flee when

Some "polite" cheetahs are among the most photographed animals in the world; their "reward" is the prey they capture during the commotion created by tourists and photographers.

Sven-Olof Lindbled; Photo Reseerchers, Inc.

they see Masai; although these Iron Age nomads are more concerned with their livestock than with pursuing wild animals, they are effective with spears and poisoned arrows. Other tribesmen can attest to the fierceness of the Masai. These tall, wandering herdsmen entered their present homelands in southern Kenya and northern Tanzania only a little more than a century ago, probably migrating south from the Nile Valley by way of Lake Turkana. Colonial records indicate that they did not settle in the Mara region until after World War I, but by the late 1930s they were firmly established in the area. Along their paths of migration, and in their new homelands, the Masai had subjugated or driven out any tribal groups in their way. (Even the Arab slave traders of the previous century feared to cross the lands of the Masai.)

Although the Masai are traditionally feared by other peoples, their sparse distribution and tolerance of wildlife has enabled many animals to thrive in Masailand that have been virtually exterminated in the lands of agricultural tribes in East Africa. Our data indicate that the Masai are usually tolerant of, or at least indifferent to, the cheetah. They universally reported that cheetahs almost never bother their carefully guarded herds, but lions sometimes do. They seldom see cheetahs, although the cats and the Masai are often in the same area. In nearly all cases, the cheetahs detect the tribesmen's approach at long distances and move away quickly without being detected. Since the Masai have taboos against eating most types of wild meat, they don't compete with the cheetah for prey.

The Masai's dogs, however, may pose a problem for cheetahs. On one occasion, we observed a big male cheetah that had eaten a wildebeest calf drag himself and his distended belly to the shade of a nearby tree to sleep off the meal. Before he had rested long, however, two Masai boys carrying spears came strolling down a nearby road with four dogs at their heels. When the cheetah raised up to investigate the noise, the dogs spotted him, ran up barking, and encircled the tree. The cheetah stood up, bristled like an alley cat, and bared his teeth. The dogs ran straight back to their startled masters, and the cheetah escaped in the ensuing confusion. Another time, at dusk, a mother cheetah defended her four small cubs against Masai dogs, but two cubs were missing the next morning.

We witnessed another example of the interrelationship between cheetahs and Masai at a small Masai settlement. This collection of low huts made of sticks and cow dung, surrounded by corrals made of cut thornbushes, had been abandoned for several weeks when a family of cheetahs approached the place. Eventually the mother and her large cubs cautiously entered the compound and thor-

Juvenile cheetahs often play "cat and mouse" with such prey as this infant impala. Young carnivores learn hunting skills as they repeatedly stalk, chase, and capture small creatures that they will eventually kill and eat.

David Burney and Lide Pigott Burney

oughly explored the dwellings. We saw cheetah families playing near abandoned settlements on two other occasions. Masai are traditionally quite mobile, changing abodes every year or so; apparently cheetahs quickly reclaim territory they have temporarily lost to these nomads.

Cheetahs must cope with other, more permanent types of human dwellings in the Mara. Tourists are accommodated in luxurious tented camps and hotels. An even greater number of service personnel—park rangers, tour-vehicle operators, cooks, and other staffers—live nearby. In the vicinity of these tourist facilities and along the roads, construction projects employing many workers are currently in progress. All these people add up to a substantial non-Masai population in the Mara region.

When these people are on foot, cheetahs show the same fear of them as they do of the Masai. Oddly enough, road-graders, bulldozers, and even airplanes elicit milder responses—about the same as tourist vehicles. Once, as an airplane landed and taxied by a cheetah about eighty feet away, a tourist-tolerant male seized the opportunity to kill a distracted Thomson's gazelle, and did not abandon his meal even when the plane taxied back to permit the passengers to take pictures.

Construction sites appeared to have less impact than might be expected. When the workmen were not around, cheetahs were fond of lying on the fresh dirt piles left by the bulldozers. Polly, the very tolerant female, even had a litter of small cubs in a dry streambed only about 300 feet from a small gravel quarry. One consequence of this tolerant behavior was that word of her convenient location spread rapidly, and twenty tourist vehicles or more would show up each day that she remained there. Since she was just off a main thoroughfare, it was not unusual for her to have up to six vehicles at a time for company throughout the morning and afternoon period. Under such circumstances, she seemed reluctant to leave the cubs, and her hunting was restricted to periods of low visitation: early morning, noon, and evening. Thus, cheetahs may be at some disadvantage when they try to raise cubs near areas where people are concentrated.

Little is known about the potentially damaging effects of human modification of drainage, soils, and vegetation that accompany facility development in and around African game parks. Care must be taken to avoid changing the ecology of such areas and thereby upsetting the balance between the productive vegetation and the varied wildlife in these areas.

Paradoxically, while tourists and native people pose potential threats to East Africa's wildlife, they may also be the animals' only hope. We found that areas in the Mara little-used by either tourists or Masai were potentially the most dangerous for cheetahs and other endangered animals because of poaching. Wildlife authorities in Kenya feel, and we are inclined to agree, that distributing tourist facilities and ranger offices over the wildlife areas as evenly as possible would discourage poachers by monitoring what is going on.

Poaching in the Mara seems to be largely restricted to times and places where other people are not likely to be—specifically, far from tourist facilities (except in the rainy season when there are very few visitors in the Mara). Most poaching involves black rhinoceros, elephant, and leopard. The cheetah's hide brings a much lower return than the products from these other creatures (a cheetah's skin has about one-third the value of a leopard skin), and consequently cheetahs are less desirable to poachers in the Mara at present. Cheetah skins from other parts of Africa continue to turn up on the international market, however. Unlike leopards, cheetahs are not easily baited with meat. If poachers should wish to hunt cheetahs from a car, however, polite cheetahs would disappear as quickly as the rhino has in East Africa.

The market for live cheetahs is another potential threat to the animals in the Mara. Catching cheetah cubs to sell is a common practice in some other African countries. Capturing live adults to train them for sporting purposes, such as blackbuck hunting, was cited as the likely cause of the cheetah's extinction in India in the 1950s.

We saw no instances of cheetah poaching in the Mara, and persons carrying weapons were never observed to get close enough to use those weapons effectively even if they wished. But ten young cheetahs did die during the study. Cubs were killed by lions, hyenas, a leopard, and in one instance, possibly, a male cheetah. That large African carnivores kill each other's young—and in some cases, the young of their own species—has been well documented.

Although instances of cubs being killed by automobiles, drowning in a flash flood, and burning in grass fires set by Masai or poachers have been reported from the region in past years, 40 percent of the mortality among the cubs we studied was caused by other carnivores. The cheetahs' high birth rate may compensate for this loss, however. Their breeding potential is higher than that of any of the other large cats, and litters of four, five, or even six cubs are not unusual. Our observation that about half of the sixty-one known cheetahs living in the region are less than two years old (but past the critical first three months of life), suggests that cheetahs may be increasing in the Mara.

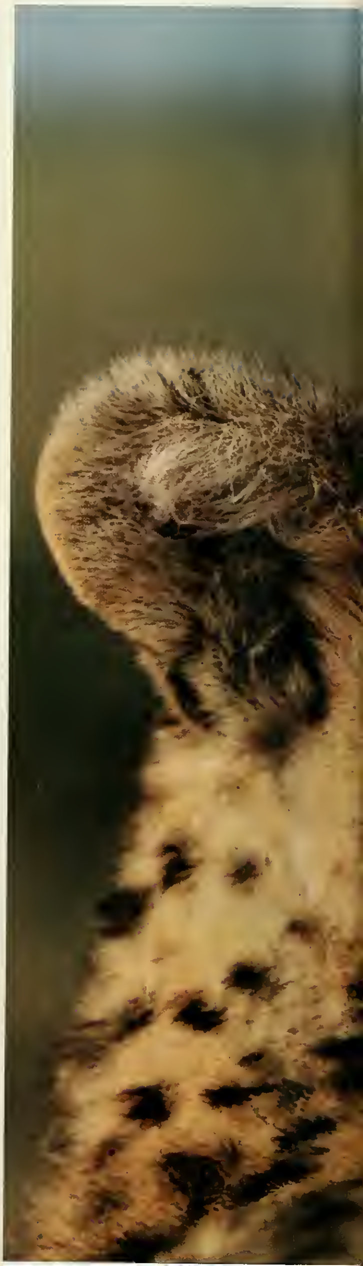
The many encounters between cheetahs and other carnivores hint strongly that these larger and more powerful animals, and not humans, are usually the cheetahs' greatest problem. These competitors seem to be more numerous in the reserve than in adjacent Masailand, and we found that the density of cheetahs was twice as high in Masailand as in the reserve.

Several rangers and Masai in the area have suggested an explanation for the patterns of distribution we observed: Lions and, to a lesser extent, the other large carnivores, are much more numerous inside the reserve, where they are protected, than outside, where they are likely to come into conflict with the Masai over livestock. The cheetah is an exception, they say (and our data confirm this). Outside the reserve, cheetah cubs face fewer problems with other carnivores, and they coexist well with the Masai because unlike lions, leopards, and hyenas, cheetahs seldom take livestock. The cheetahs detect and flee from people on foot beyond the range of most weapons, and they pass freely through sparsely populated areas without being distracted from their hunting to any great extent.

If this is true, then the effort to preserve cheetahs in the parks and reserves of East Africa would benefit from buffer zones—adjacent boundary areas with complementary land uses. The most compatible land use appears to be multiple-use range management (which fairly well describes the Masai's life style). Such lands produce both livestock and wildlife, but lions are likely to be kept in check because of their relative incompatibility with even low-density human populations.

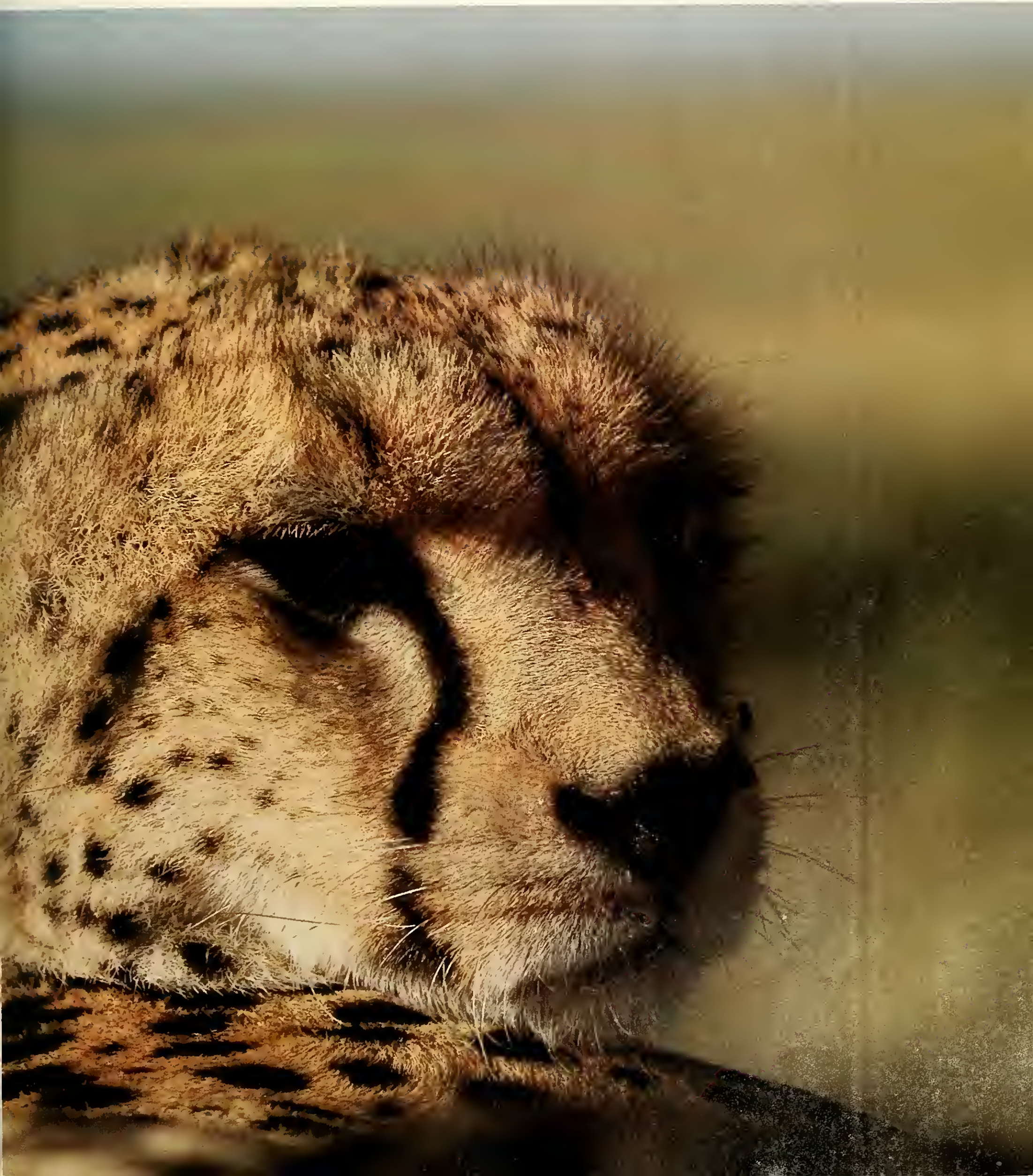
Human proximity is not new to the cheetah. Anthropologist Richard Leakey of the National Museum of Kenya points out that humans and their nearest ancestors have frequented the Mara for three million years or more. So, presumably, has the cheetah. If current conditions in the Mara region were to remain stable, I believe the cheetah would have a good chance of not just surviving but even increasing in numbers. Human activity, however, will undoubtedly continue to change the land. Intensive fenced ranching and large-scale wheat farming are on the increase in the Mara region. Wildlife authorities are already killing buffalo, wildebeest, and other grazers that are invading the Mara wheat fields, and strong, expensive fences are being erected. These agribusiness schemes are being financed with large loans from the World Bank.

Tourism, too, could possibly increase in the Mara until it makes the area less suitable for the cheetah. This may have already happened in a few national parks in Kenya. On the other hand, a period of global economic decline or political instability could result in diminished tourism, leaving the superb park system of Kenya without its present strong economic justification. But for now, we can still witness the breathtaking speed and agility of cheetahs, in spite of other carnivores and human interference. Like all creatures, though, this great cat is completely at the mercy of our uncertain future. ☐



This adult cheetah picked the hood of a Toyota Land Cruiser on which to rest. Such tameness could prove fatal to the big cats if poachers in East Africa decide they are profitable.

George W. Frame and Lory Frame



Fallow Field Guide to Birds

Old farm fields of different ages support different communities of plants and attract different species of breeding birds

by Wesley E. Lanyon

Field sparrows are among the first birds to breed in fallow fields. Their open-cup nest, sometimes built on the ground, has an outer shell of grasses and weed stalks and a lining of finer grasses and plant material.

Alvin E. Staffan

On its way from bare soil to woodland, fallow farmland is characterized by a constantly changing succession of plant communities. Birds vary in their response to the biological and physical features of this continuum, and as a field changes, so do the birds that breed there. Investigators interested in avian succession usually sample simultaneously the birds of a number of sites representing different stages of succession. This approach, which assumes that the oldest site has passed through stages represented by the other sites, has the advantage of enabling the accumulation of data in a short period of time, but it introduces undesirable variables associated with differences in the communities being studied. The alternative to this composite picture of succession is to follow the same study area over a longer period of time. This approach has not been practical for most investigators because of the time commitment involved and the need for an environmental laboratory seldom available to research institutions.

When the American Museum of Natural History established its Kalbfleisch Field Research Station in Huntington, New York, in 1958, I sensed an opportunity to use a combination of the two approaches. I wanted to determine the sequence in which bird species become established in fallowed fields and the effect upon these species of subsequent plant succession toward a more mature woodland. What are the environmental factors that make the habitat suitable for breeding individuals of particular species? At what age does an abandoned field support the greatest variety of breeding birds or the greatest number of individuals?

The unique resources of the Kalbfleisch Station, including student assistance for censusing birds and plants, made such an intensive research program both feasible and attractive. The field laboratory's ninety-four acres, situated on Long Island less than forty miles from the center of New York City, had been cultivated, pastured, or operated as farm woodlots for at least 150 years before they were acquired by the Museum. All agricultural activity ended after the 1954 harvest, and several of the fields have remained fallow ever since. In my study, which lasted from 1958 to 1977, plant succession was arrested on selected study areas by means of various management techniques—cultivation, controlled burning, application of silvicide, and mowing—to maintain a diversity of habitats and to permit controlled studies of how certain animal populations respond to successional and experimental changes in the plant communities. Eight fields, averaging about three acres in size and representing stages in plant succession from bare soil to a 45-year-old field, were available for study. In addition, a nine-acre closed-canopy oak woodland, which had been virtually clear-cut in 1910 and subjected to minimal management since then, enabled me to document the presence or

Right: One year after the end of cultivation, this field supported sparse herbaceous vegetation and one redwing nest. Below: Eleven years later, open, shrubby woodland provided breeding habitat for four species.

Wesley E. Lanyon

Wesley E. Lanyon

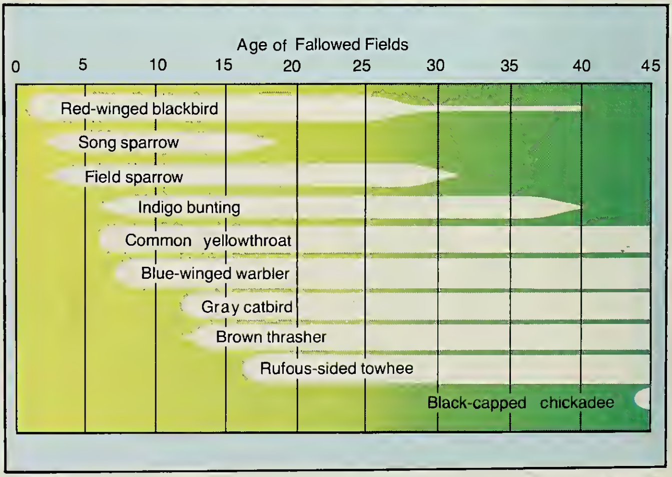
absence in an advanced stage of succession of birds found in earlier stages.

The breeding bird censuses were counts of all individuals, not estimates of population size. I gave particular attention to nest location and construction and to light readings taken at the nests to provide an index of relative nest cover. In a parallel study of plant succession, which characterized the vegetation of each of these study areas, emphasis was placed on the average cover of herbaceous and upright woody species and on the density of trees by height and by diameter.

During the first five years after cultivation ceased, my study areas supported only sparse herbaceous vegetation. Although attractive when in flower, fields of oxeye daisy, hawkweed, and ragweed provide little shade or cover for nests. Only three species bred under these conditions of early succession: red-winged blackbird, song sparrow, and field sparrow. Light readings taken at the nests of these pioneering species were nearly equivalent to readings taken in completely open areas nearby.

Adequate support above ground level—rather than shade or cover—appeared to be the primary limiting factor determining placement of redwing nests. Since the stalks of such pioneering forbs as goldenrods and dogbane provide this support, redwings were territorial from the first year after cultivation. Where annual mowing arrested succession at the herbaceous stage, grasses became dominant and redwings were the only birds to continue use of the fields. Sturdy clumps of orchard grass became important for nest support. Too few song sparrows nested in my study

As old fields mature into woodlands, they provide increased cover at the nest (green shading). Requirements with respect to nest cover may help determine the order in which birds breed and later disappear.



Joe LeMonnier

For this female red-winged blackbird, shade and cover for the nest are less important than height above the ground. Redwings will nest close to the ground on grasses, but they prefer taller, woody plants.

Alvin E. Staffan

areas to allow comparisons with other pioneering species, but for field sparrows, the importance of seedlings or small saplings of woody vegetation—either as nest support or song perches for the males—may rule out continued nesting in fields held at the earliest stages of succession.

The significant change in appearance of the fields six to ten years after cultivation ceased was the increasing dominance of the goldenrods, among the herbaceous species, and of upright woody vegetation, notably bayberry. Redwings shifted from goldenrod to bayberry as the principal support for their nests, which were now built, on average, higher above the ground. Also during this time, indigo buntings, common yellowthroats, and blue-winged warblers first appeared in my study areas. Their nests generally were located within or at the base of dense clumps of goldenrod, where light penetrated less than at redwing nests. I believe the appearance of these three species in fallow fields is delayed primarily by their dependence on clumps of bayberry and other woody vegetation for song perches and for cover during their approaches to and departures from their nests. Where succession was kept at the herbaceous stage, these birds tended to build their nests closer to the perimeter of the study area, near wooded fencerows or shrubby woodlands. This "edge effect" on the location of nests was especially pronounced in blue-winged warblers, which frequently sang from and foraged within the more mature trees bordering the old fields.

Fields fallowed for eleven to twenty years could be characterized as shrubby

The gray catbird is one of the last species to breed in an abandoned field. The optimum situation for its bulky stick nest is in a thicket of woody vegetation three to six feet high.

Alvin E. Staffan

Doug Wechsler

Forty years after it was last farmed, this field supported many trees with diameters of several inches or more. As dead trunks became available, chickadees, which excavate holes for nesting, began to breed there.

woodlands, dominated by dense growths of bayberry but with increasing numbers of small trees (cherries, crab apples, red cedars, and birches). Thorny thickets of multiflora rose, bullbrier, and several species of bramble often made walking through these study areas difficult. The advent of these dense thickets and brambles was the prelude to the establishment of breeding pairs of gray catbirds and brown thrashers, songbirds that generally construct nests within such thickets. The rufous-sided towhee was the next species to nest in these shrubby woodlands. Although sometimes located in brambles or thickets of bullbrier, most towhee nests were on the ground, in moderate to heavy leaf litter and with dense cover provided by goldenrods and poison ivy. Of all nests for which readings were taken, light intensities averaged lowest at towhee nests.

Unlike species that construct nests from grasses and other materials, birds that nest in cavities have their breeding distributions influenced primarily by the availability of trees with diameters wide enough and pulp soft enough to permit excavation of a suitable hole. The black-capped chickadee, the smallest hole-nesting species on the station, first nested in the oldest of my eight field communities during the last two years of the study, forty-four and forty-five years after the cessation of cultivation. I found two nest cavities, both located in dead stubs of gray birch trees about three and a half inches in diameter, which probably represents the smallest trunk in which chickadees can excavate a hole. Some ten years earlier, this field had supported birch trees of similar size, but there were then no dead stubs available for cavity nesters. In the fortieth year following the end of cultivation, a pair of chickadees and their brood (presumably fledged from a nest just outside the area) frequently foraged in the field. By that time, twenty-four birch trees with diameters in excess of three inches were growing in the field, and five were dead. But only two of these five were free from vines and hence suitable for excavation. It is noteworthy that the first two chickadee nest cavities, excavated four and five years later, were in these two dead birch stubs. Chickadees nested in the closed-canopy oak woodland throughout the study period, as did another cavity nester, the downy woodpecker. Because of its greater size, the woodpecker is probably unable to find suitable nest trees in fields fallow for less than fifty years.

An early successional species, the blue-winged warbler often builds its nest in a clump of vegetation on or near the ground. This nest has been parasitized by a cowbird, whose big young are now fed by the tiny warbler.

Alvin E. Staffan

John James Audubon Porcelains

"The Birds of America"

John James Audubon's resplendent birds come to life in exquisite figurines to treasure and display. Robin, Hummingbird and additional selections from $45. Approx. 6" tall. Wooden base and Certificate of Authenticity included. Specify "The Birds of America" Collection wherever finer gifts and collectibles are sold. John James Audubon Porcelains, Northbrook, IL 60062.

© 1982, John James Audubon Porcelains, Ltd.

Free!

Edmund Scientific Catalog

4,000 Unique Items

Astronomy, Microscopy, Biofeedback, Weather, Alternate Energy, Binoculars, Optics, Magnets, Magnifiers, Tools, Unique Lighting, Lab Equipment, and much more. Over 4,000 unique and fascinating products. Send for our FREE, colorful 1982 Edmund Scientific Catalog...Today!

Rush me your free catalog!
Name __________
Address __________
City __________
State __________ Zip __________

Clip And Mail Coupon Today To:
Edmund Scientific Co., Dept. 8211E-10
Edscorp Bldg., Barrington, N.J. 08007
No. 3455 ©1982 Edmund Scientific Co.

Now available with optional wooden floorboards!

The Quality Alternative to High-Cost Inflatable Boats!

Why pay $600. to $1000. or even more for an inflatable boat?
Sea Eagles pack small, last for years and cost $110. – $540.
Canoes, dinghies and motormount boats for fishing, river running, camping and yacht tending.

Sea Eagle 8, shown: • 9'7" x 4'6" • 31 lbs. • Holds 4 adults • 3 hp capacity • Costs $220.

Write for our FREE brochure: Sea Eagle; Dept. NH5B, St. James, NY 11780
Or phone:
516-724-8900, 8:30 AM to 4:30 PM EST.

SEA EAGLE

To the extent that my study areas would permit, I was equally interested in determining the sequence in which songbirds disappeared as succession from field to woodland continued. The oldest old-field community on the station was a five-acre woodland that I studied for a sixteen-year period, from the twenty-ninth to the forty-fifth year after cultivation ceased. It had developed into a largely open-canopy woodland, dominated by oak, cherry, and dogwood trees, several with trunks up to fifteen inches in diameter. The pioneering species of songbirds were still present in this open woodland community at the beginning of my study but were no longer nesting in it when the research ended. Field sparrows failed to make use of the higher nest sites afforded by the larger shrubs and disappeared from this shrubby woodland thirty-two years after cultivation. Red-winged blackbirds maintained breeding territories in the corner of the woodland nearest open fields up until the fortieth year following cultivation. Five nests were found, all in small saplings (dogwood, crab apple, and scarlet oak), at heights greater than usual in the younger fields and in locations where there was little shade. Indigo buntings were last observed in this open woodland in the thirty-ninth year after cultivation. In contrast, common yellowthroats and blue-winged warblers showed no sign of diminishing numbers at the end of the study, and gray catbirds, brown thrashers, and rufous-sided towhees appeared to find optimal nesting conditions in this open woodland.

None of my fields were old enough to document the disappearance of yellowthroats, blue-winged warblers, and catbirds as breeding birds. All, however, were missing from the initial surveys of the nine-acre closed-canopy oak woodland that had been clear-cut in 1910. Brown thrashers maintained breeding territories around the perimeter of this oak woodland nearly until the end of the study. Only one thrasher nest was found within the boundaries of the study area, but there were several along the periphery and the adults routinely moved their fledglings into the dense woodland to forage. Rufous-sided towhees will also continue to breed in or around woodlands in which the canopy has closed. As with the thrasher, I found only one nest within the study area, but other towhee nests were located just outside the site. This species was territorial in the oak woodland area up through the final year of the study, sixty-seven years after the woodland had been clear-cut.

The sequence in which species of birds no longer nested in my study areas was the same as the sequence in which these same species had become established as breeding birds during the early stages of succession. Moreover, if the species are listed according to increasing degree of cover at their nests, as indicated by the relative amount of sunlight reaching the nest, the order is the same. The concordance among these three sequences suggests that species-specific requirements with respect to cover at the nest play an important role in determining which stages of old-field succession a species finds attractive for nesting. For some species, additional factors, such as the availability of song perches and of cover for foraging near the nests, seem to be equally important, and hole-nesting species have special requirements relating to their need for trees large and soft enough for excavation.

Comparing all eight fields, I found that the density of breeding birds, in terms of the number of territorial pairs of all species, was highest in the older fallowed fields. An average of four pairs per acre bred in my 35-year-old shrubby woodland, for example, while an average of only two pairs of breeding birds could be found on a one-acre field only ten years old. Clumps of woody vegetation clearly increased the carrying capacity of these communities. Fields in which succession was arrested at the herbaceous stage or that were maintained as grassland through annual mowing had a density of only one pair per acre.

The variety of bird species was greatest in fields that had been fallow for fifteen to twenty-five years, at which time a three-acre field could support six or seven breeding species. This high level of diversity can be explained by the continued presence of pioneer species when birds more characteristic of shrubby woodlands and thickets have already become established. My oldest fields, although having the highest density of birds, showed a drop in species diversity as the pioneer species disappeared. The implication is that the 35-year-old field can support the greatest number of birds because of the abundance of nest sites and food, but that the progression toward a dense shrubby woodland reduces habitat diversity.

This orderly and predictable succession of birdlife on abandoned Long Island farmland is typical of what occurred throughout many eastern states when farming became uneconomical and fallowed fields were permitted to return to woodland. The actual species involved differ geographically, but the sequence is predictable for a given locality. This replacement of avian communities, as one community of species is placed at a disadvantage and gives way to another, has been responsible for significant fluctuations in the number and variety of birds that we see around us. Knowledge of the habits of different birds, and of how they respond to succession, gives us a better basis for understanding these fluctuations.

BIRD'S-EYE VIEW

Designed in collaboration with internationally famous ornithologists, Swift's Audubon and Osprey binoculars give you a superior combination of performance and durability.

OSPREY MK. II
weather-protected
binocular

The 8.5x,44 AUDUBON Wide Angle is tops in the field — with an extra-wide field of view (445 feet), crisp close focusing to 13 feet, and hairline definition.

The 7.5x,42 OSPREY is distinguished by its rubber armor protection and slip-on rainguard that eliminate the need for a cumbersome case and allow it to be used safely in virtually any weather conditions. Close focusing to 13 feet.

For technical excellence and enduring quality, Swift binoculars are the natural choice.

SWIFT®

TECHNICAL
EXCELLENCE
ENDURING
QUALITY

For More Information: SWIFT INSTRUMENTS, INC., 952 Dorchester Ave., Boston, MA 02125 or P.O. Box 562 San Jose, CA 95106

THE MARKET

Art

AMERICAN INDIAN CRAFTS: Southwest Indian pottery, baskets, rugs, kachinas. Northwest Coast Indian masks, totems, graphics. Eskimo sculpture. No catalog. One-of-a-kind pieces, individually photographed. Priced $100/up. Photos and data available. Specify interests. Box 5896. Sherman Oaks, CA 91413. (213) 789-2559

ANCIENT CHINESE PATTERNED, handformed, end-grained 12¼″ decorative wooden vase. $75. Smart's, 4th Street, Rocheport, MO 65279

AUDUBON PRINTS, Original handcolored birds and animals. Write Audubon, 9720 Spring Ridge Lane, Vienna, VA 22180

AUTHENTIC CARVED FIGURES; Solomon Islands (Southwest Pacific), indigenous hardwood, nautilus inlay. Priced $250/up, request slides; 756 Arlington Ave., Baton Rouge, LA 70806

BROKEN NOSE IROQUOIS FALSE FACE, $90, request photo, other masks available, McCoy Imports, Liberty, NY 12754

Pre-Columbian Collectibles!

PARADISE OF TLALOC (200 B.C.-A.D. 900), the Mexican rain God of the Aztecs—only one of many original serigraphs and rubbings of Aztec and Maya ruins! Complete color catalog $2 (deductible with order). **BERNARDO**

2400 Westheimer Suite 108W (NH2)
Houston, TX 77098

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHQ, 84 Fifth Avenue, New York, NY 10011.

Books

BOOKFINDING Librarians search worldwide titles or subjects plus 150,000 indexed stock. PAB, 2918 Atlantic, Atlantic City, NJ 08401 (609) 344-1943

CORE OF CREATION—Profound scientific model generates evolution, quantum physics, light, time, consciousness, more. $7.50, guaranteed. Syzygy, Box 18-C, Rush, NY 14543

HERPETOLOGICAL BOOKS over 5,000 items listed. Send $2.00 U.S., $4.00 AirMail. Natural History list in preparation. Herp. Exchange 117 E. Santa Barbara Road, Lindenhurst, NY 11757

ORNITHOLOGICAL books, scarce, out of print, rare. Natural history color plate. Catalogues $2.00. Book Chest, 19N Oxford Place, Rockville Centre, NY 11570

OUT OF PRINT BOOKFINDER, 4051 N.H. Walnut, Eureka, CA 95501. Send wants or send 2 stamps for catalog.

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalogue: Hamilton's, 98-55 Clapboard, Danbury, CT 06810

TRAVEL, ADVENTURE, AND EXPLORATION BOOKS. The usual and the unusual. Free catalog from The Armchair Explorer, Dept. NH, 333 Bellam Blvd., San Rafael, CA 94901

Collectors' Items

BIRDS, ANIMALS OR FLOWERS on postage stamps from many countries. 25 different 35¢. George Ford, P.O. Box 5203-N, Gulfport, FL 33737

IDENTIFIED PETRIFIED WOODS. Polished. For decorators, schools, collectors, museums. Fossil leaves. Free price list. Beaver-Hood Company, Box 177, Prineville, OR 97754

NATIONAL GEOGRAPHICS 1888-1982, issues Book Publications, Collectors Items, Send Wants Buxbaum Geographics, Box 465-NH, Wilmington, DE 19899

Correspondence

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin 11, West Germany

PENFRIENDS-ENGLAND-USA. Make lasting friendships through correspondence. Send age, interests. Free reply. Harmony, Box 89NH, Brooklyn, NY 11235

SINGLE BOOKLOVERS gets cultured persons acquainted. Nationwide. Established 1970. Write Box AE, Swarthmore, PA 19081 or call 215-566-2132

Education

FIELD COURSES IN NATURAL HISTORY. College credit, Write Aspen Center for Environmental Studies, Box 8777A, Aspen, CO 81612

WILDERNESS ECOLOGY course taught in Idaho's Selway-Bitterroot primitive area July 17-31. Three hours of biology credit. Total cost tuition, meals, camp site, and packer $575. For information contact Northern Illinois University. College of Continuing Education, DeKalb, Illinois 60115, 815-753-1458

WILDERNESS/TRINITY PHOTOGRAPHY WORKSHOPS, instructors David Cavagnaro, Boyd Norton, Mary Ellen Schultz. Spring: Idaho, Maine, Utah. Summer: Trinity Alps, California, Colorado, Snowy Range, Wyoming. Fall: Autumn Color, Ontario, Canada, Canyonlands. Free brochure: Wilderness/Trinity Workshops, 216 Marquis Place, Santa Maria, CA 93454

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest handbook, $2.00 (guaranteed). Australian International, Box 19107-RR, Washington, DC 20036

AUSTRALIA—NEW ZEALAND—THE WORLD! 50,000 Jobs! Big pay. All occupations. Transportation. Tax free. Computerizerd reports $2.00. Jobworld, Box 681-NH, Cypress, CA 90630.

AUSTRALIA . . NEW ZEALAND want you! - Jobs! - Paid Transportation! - Most comprehensive directory available! - $2 - Moneyback guarantee! "Australia" 2208-C5 Wisconsin Ave, NW, Washington, DC 20007

NUTRITIONISTS—A New Career Field

Be a **Certified Nutritionist**
- Food Stores
- Health Care Facilities
- Schools
- Community Organizations
- Food Service Businesses
- Your Own Nutrition Counseling Practice

Home Study Program Includes
- Physics & Chemistry
- Human Physiology
- Nutrients-Food, Vitamins Minerals
- Diet Management
- Buying/Storage/Cooking
- Nutrition Counseling

Toll free call 1-800-821-5234 312 W. 8th Street
NUTRITIONISTS INSTITUTE OF AMERICA • Kansas City, Mo. 64105

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RR, Washington, DC 20036

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . . Intermountain 4Y, 3506 Birch, Cheyenne, WY 82001

TEACH HERE- TEACH ABROAD: School, College openings: USA $5.95; Abroad $5.95. Placement sources: USA $4 95; Abroad $4.95. EISF, Box 662, Newton, Massachusetts 02162

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Japan. Sampler: 4/$2.98. Free Brochure. Multinewspapers, Box DE-205, Dana Point, California 92629

Garden

GROW YOUR OWN TALL GRASS, bright bloom prairie. Informative booklet $5. Private Prairies, 807 Maple, Decorah, IA 52101

Gourmet Interests

DELICIOUS FISH AND CHIPS from British housewife $1.00 SASE. Orthmann, Long Pond Rd., Goffstown, NH 03045.

MINNESOTA WILD RICE. $7.00 pound, five pound minimum. Floura Bros., Box 44C, Blackduck, MN 56630

SOLAR ROASTED GRANOLA—Solar heat used for roasting granola made with oats, peanut pieces, and honey. $2.00 a pound, minimum order 4 lbs. plus $1.00 handling in continental US, west of Denver an additional $2.00 for shipping. Koinonia Partners, Route 2, Americus, GA 31709

Government Surplus

GOVERNMENT SURPLUS! Millions of items (Including Jeeps) . . . low as 1¢ on dollar! Most complete Directory available—$2.00. Disposal, Box 19107-RR, Washington, DC 20036

JEEPS, CARS from $35!—700,000 items! Government Surplus—Most Comprehensive Directory Available Tells How, Where To Buy—Your Area—$2—Moneyback Guarantee—"Surplus Information Services," Box 3070-DC5, Santa Barbara, CA 93105

Merchandise

FLOWER NOTE CARDS—Rose, Iris, Narcissus, double 5½ × 3½, envelopes. $5/dozen. CARDS, 4 Pond Brook Circle, Weston, MA 02193

FOR LOVERS the most intimate book of poems ever written for those in love and those alone. For your copy send $10.00 + $1.50 shipping to Vanstead, Box 382 Dept N, Freehold, NJ 07728

HIGH QUALITY, hand-made, unique decorative items. Send $1.00 to Unlimited Special Effects, Inc. 3807 N. Lincoln, Chicago, IL 60613 for brochure.

"I LIKE IT WILD® . . ." Wilderness/wildlife posters, T-shirts, note cards. Send stamped envelope: Wilderness Dreams®, Box 4455-N, Shawnee Mission, KS 66204

KITS! Build your own dulcimer, mandolin, even harps, lutes, and harpsichords. Free catalogue. Hughes, 4419 West Colfax NH, Denver, CO 80204

Misc

INTEGRATE THE BEST OF URBAN AND RURAL LIFESTYLES with progressive political and social values in one of five established rural communities. Nonsexist, non-racist, gentle cultures based on cooperation, equality, and environmental concern. For free information ($3.00 donation appreciated) write: Federation of Egalitarian Communities, Box E-NH 52, Tecumseh, Mo. 65760.

Optical

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON. Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired. Large stock. Orders filled postpaid day received. Birding, Box 5N, Amsterdam, NY 12010

OPTIC DISCOUNTS: Binoculars—Telescopes—Brand Names. Free List. Thos. Manetta, Box 12, 61 Hoffman Ave., Elmont, NY 11003

Personals

MEET SINGLES Mexico, Orient, Europe, Australia. Free information. Write: International, Box 1716-NH, Chula Vista, CA 92012

Photography

INTRODUCTION TO CLOSE-UP NATURE PHOTOGRAPHY. Equipment, lighting, composition; thorough, concise. $6 Photos Unlimited, 35 Minocqua Dr., Rochester, NY 14617

Real Estate

FREE CATALOG. Describes and pictures farms, ranches, acreages, businesses and town and country homes from coast to coast. UNITED FARM AGENCY, INC., 612-U W. 47th St., Kansas City MO 64112. Call Toll-Free: 1-800-821-2599; MO res. call Toll-Free: 1-800-892-5785

GOVERNMENT LANDS . . FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00. Lands, Box 19107-RR, Washington, DC 20036

NEW FREE. BIG SPRING CATALOG! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Recreation, Retirement buys! Selected best throughout the U.S. Over 700 offices, 43 states all across America! Yours free from the world's largest! Strout Realty, Inc., Executive Park Tower, Dept. 5390, Albany, NY 12203 Call toll free 1-800-641-4266

Rentals

ABACO, BAHAMAS—3 bedroom seaside rental cottage. Ocean view with miles of white sand beach and offshore coral reefs. Secluded subtropical setting. Weekly/monthly vacation rentals (off season rates). Pingeon, 401 E. 65th St., NY, NY 10021. (212) 794-0318

Resorts

ADIRONDACK LODGES on Upper Saranac Lake. Available for two weeks or a month, July through September. Everything provided for comfortable living in the quiet woods. $650-$1,700 for two weeks. Please write Bartlett Carry Club, RFD 3, Tupper Lake, NY 12986

ADIRONDACK WILDERNESS, sparkling mountain lake, informal, great tennis, food, hiking, horses; family rates. American Plan Timberlock, Box NH, Indian Lake, NY 12864

ALASKAN WILDERNESS FAMILY invites you to share their coastal wilderness. Sincere, informal hospitality in a spectacular sea and mountain panorama. The place for those desiring quiet solitude; for birders, naturalists, photographers. 30 foot tides, prolific seabird and marine life. Glaciers, nesting eagles, bears, sea otters, seals, whales, untracked beaches, forest trails Pull in crab and shrimp pots; catch salmon, trout, halibut; dig clams, gather mussels. An in-depth, educational experience. 8 guests only. $1125.00/5 days. Cozy cabins, gourmet meals. Called America's best wilderness lodge. The McBrides, China Poot Bay via Box 956NH, Homer, AK 99603, radio/phone (907) 235-8910. Write for brochure.

LITTLE ST. SIMONS ISLAND

One of Georgia's "Golden Isles"

Birding, beachcombing, riding, wildlife photography, fishing or just relaxing on a secluded 12,000 acre island with miles of unspoiled ocean beaches, forests and marshes. Over 200 species of birds. Maximum of 10-15 guests at a time. Excellent food and accommodations. Professional naturalists on the staff. P.O. Box 1078N, St. Simons Island, GA 31522 Phone (912) 638-7472

MAINE SALTWATER FARM, cottages completely equipped. Seals, heron, osprey, wildflowers, rocky shore. From $175. weekly, Windrise Farm, Jonesboro, ME, 04648, 207-434-2701

OLD FASHIONED, Secluded Farm on Cape Breton Island offers log cabins, excellent meals, peace to a few guests. $250/week Write: John Gardner, Orangedale, Nova Scotia

WESTERN ADVENTURE on authentic ranch. Fun for all ages. Operating stock ranch 50 miles north of Yellowstone Park. A birders paradise. Riding, fishing, pack trips. All ranch activities. 63 Ranch, Box NH979, Livingston, MT 59047. Tel. 406-222-0570

Tours/Trips

AFFORDABLE INDIVIDUALITY: uncommon tours to Latin America, Africa, Asia, Europe. For demanding individuals/small groups Fully assisted, skilled guides where needed. FORUM TRAVEL, 2437 Durant, Berkeley, CA 94704 (415) 843-8294

ALASKAN WATER ADVENTURES. Kayaking, Rafting, Birding in Prince William Sound and Copper River Basin. Open Door, Box 1185N, Cordova, Alaska 99574 (907) 424-7466

ARCTIC WILDLIFE. Experience the wild Arctic this summer, escorted by naturalists/explorers. Baffin Island trek into Pangnirtung Pass, camping See snowy owls, Arctic foxes. Spitsbergen, cruising round coast in yacht, landing each day to see wildlife. East Greenland trek, visit Eskimo villages, glaciers, spectacular viewpoints. Camping "Vikings in the Arctic". Survey Norse ruins in Greenland and Iceland, staying at hotels. Send airmail letter to ERSKINE TOURS, 14 Inverleith Place, Edinburgh, Scotland, for details, stating preferred expedition.

AVID TOURS Take a fresh look at Canada's Atlantic Provinces with Roger Burrows, author of "A Birdwatcher's Guide to Atlantic Canada". Visit some of the largest seabird colonies in the world, seek out hard-to-find boreal birds, or just enjoy the traditions and friendliness of Canada's oldest settlements. There is even a tour to suit those who want to rough it to search for European shorebirds along Newfoundland's rugged east coast Further details of tours and books available from Avid Services, PO Box 73, Glovertown, Newfoundland, AOG 2LO, Canada

DISCOVER BAJA! Join experienced naturalists and crew for leisurely ocean-going explorations of the wilderness islands and lagoons of Baja's Pacific coast, the Sea of Cortez, or Mexico's tropical west coast Enjoy whales, seals, dolphin, birding, fishing, nature study, island hiking, and more! Excellent photo opportunities. Small groups,relaxed pace. Trips 4-10 days year-round for individuals or groups. Color brochure: PACIFIC ADVENTURES CHARTER SERVICE, 2445 Morena Blvd., Suite 200H, San Diego, CA 92110 (714) 275-4253

GALAPAGOS Explore with Scripps Aquarium. Land & Sea. Professional ecologist escort Arranged by Lindblad Tours. Nov. 17-Nov. 30, 1982. Write Scripps Aquarium, La Jolla, CA 92093

GALAPAGOS HIKING AND SAILING EXPEDITIONS. Small groups. 1982 dates: February 4, April 22, July 7, August 4. Charters: Machu Picchu options and Chili ski options. Inca Floats, 5982N Balboa, Oakland, CA 94611 (415) 339-9095

GALAPAGOS ISLANDS. Economic guided tours from $1638. Including airfare. 4, 5, 8, & 15 days Galapagos, all meals. Options, mainland Ecuador, Amazon, Cuzco/Machu Picchu. University credit available. Joseph Colley, Last, Inc., 43 Millstone Rd., Randallstown, MD 21133 301-922-3116

INDIA/NEPAL WILDLIFE SAFARI: Outstanding game observation in three major reserves + Delhi, Taj, Kathmandu, Himalayas. $1375.00. Also, comprehensive program of trekking expeditions in Nepal's Everest & Annapurna regions from $895.00. Airfares additional. Free brochure. Himalayan Travel, Inc., Box 481-NH, Greenwich, CT 06830. Toll Free (800) 243-5330

KENYA. Spectacular birds, mammals, scenery. October 23-November 15. Expert leadership. SHRIKE TOURS, RFD 1 Box 802, Fort Kent, ME 04743

KENYA—Very exclusive photographic safaris for up to six, choosing your own itinerary, at Packaged Tour prices with Mervyn Carnelley, Box 79, Naivasha, Kenya

MADAGASCAR/RWANDA/TANZANIA/ZAIRE: Living Fossils, Gorilla Tracking, Wildlife, Afro-Asian cultures. Forum Travel, 2437 Durant, Berkeley, CA 94704 (415) 843-8294

MAINE ISLAND ECOLOGY. Marine biology, botany, and ornithology on 200-acre island. Exciting opportunity for high school students interested in environmental studies. Faculty/student ratio 1:5. Over 10 years of operation. From June 21 to July 9 or July 13 to July 31. Contact. Maine Island Ecology, Academy of Natural Sciences, 19th St and the Parkway, Phila., PA, 19103

MAINE NATURALIST'S TOUR—Acadia to Machias, puffins and pennyworts. July 11-17, 1982, $467. Blue Sky Adventures, Audubon Travel Group, Oak Ridge, NJ 07438. (201) 697-7233

NEW ZEALAND WALKABOUT: Escorted nature and hiking tours in NZ's scenic National Parks, plus the Milford Track Pacific Exploration Company, Box 3042-N, Santa Barbara, CA 93105

PERU: TREKKING THE INCA TRAIL. Hike through the heart of the ancient Inca empire to Machu Picchu. Explore colorful native markets and fascinating ruins in the Urubamba Valley (Sacred Valley of the Inca). July 30 - August 13, 1982 (15 days). Cost: $1190. Write: High Country Passage. P.O. Box 1100, Hamilton, MT 59840. (406) 363-2555

SAIL-RELAX-ENJOY and explore the waters of Long Island, Block Island, and Vineyard Sounds on board the 60' yawl "MARILEE". Visit islands, beaches, and historic ports some of which are accessible only to select individuals. Coast Guard approved and licensed. Parties up to six. Reservations, information, call PORT YACHTS, Port Jefferson, N.Y. Tel: 516-331-1430

SITES & SCENES: LATIN AMERICA/AFRICA/ASIA/EUROPE. Largest program of uncommon nature and culture trips (including trekking & special interest tours), at unbeatable prices. Groups or individuals. Favorites: Peru (MachuPicchu, Amazon, "Explorer's Inn", Titicaca, Nazca). Ecuador: Galapagos Islands, Devil's Nose Railroad, Indian Markets. Mexico: Mayan Worlds. Madagascar: "Land of the Living Fossils". Rwanda/Zaire: Gorilla tracking. Kenya/Tanzania: Safaris. Namibia. Botswana. Egypt: Archeology. India: Festival of Lights. Europe: "Photokina 1982", Textile arts. FORUM TRAVEL INTERNATIONAL, 2437 Durant, Berkeley, CA 94704. (415) 843-8294

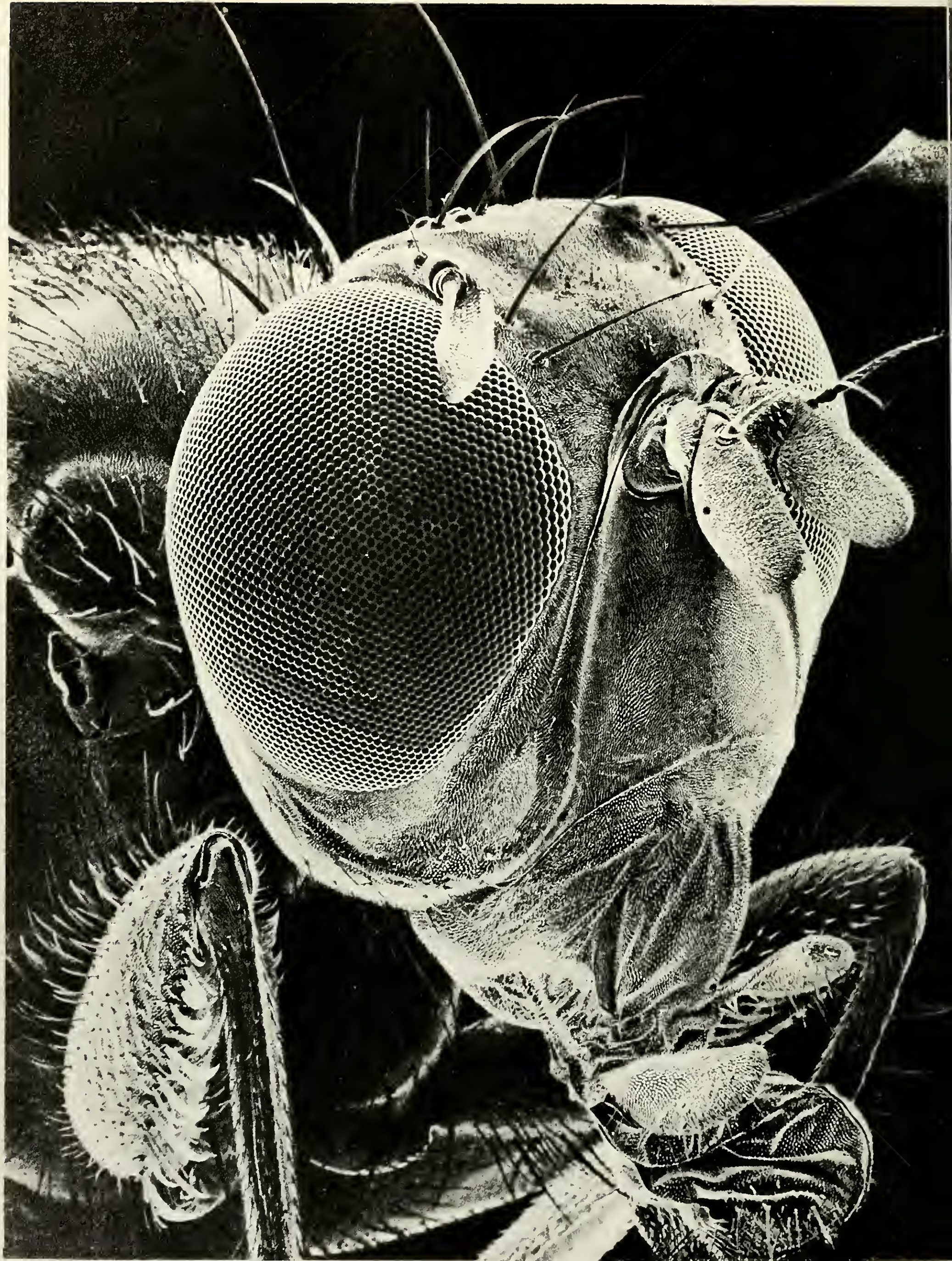
VACATION ON HORSEBACK—Washington's Beautiful Cascades—Free Brochure. Lightning D Ranch, R#1 Box 1000, Moxee, WN 98936

WILDERNESS CANOE TRAVEL. Alaska, Maine, and Canada. Completely outfitted trips with small groups. Northern Rivers, Box 326, Orono, ME 04473

RATES AND STYLE INFORMATION

$1.75 per word; 16 word ($28) minimum. *Display classified* is $150 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY to: The Market, NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024 Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—1st of the month, two months prior to cover date (the January issue closes Nov. 1). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

Box numbers, telephone numbers, and hyphenated words count as two words; abbreviations and zip codes as one word each. All states are shown in two-letter code followed by zip, then telephone (with area code), if desired. Occasionally, slight editing is required for clarity. Thank you!



Male Mediterranean fruit fly X100

David Scharf; Peter Arnold, Inc.

Invasion of the Medfly

Come into my country, said the human to the fly. Invitation accepted

by William H. Jordan, Jr.

During the past two years the Mediterranean fruit fly, *Ceratitis capitata*, has been the cause of a great deal of civic consternation and political turmoil in California. Surviving on edible as well as ornamental fruits and berries, the insect has colonized a strip of land extending from Los Angeles to San Francisco. It has resisted a massive campaign in which helicopters sprayed malathion bait and dropped billions of sterilized flies over vast tracts of suburbs, while thousands of state employees picked and destroyed the fruits the fly is known to breed in. Now farmers in the central San Joaquin Valley are concerned that the fly will invade their area and devastate their $14 billion industry. Some economists predict annual losses ranging from hundreds of millions to billions of dollars. But these fears could be premature; the medfly, a species originating in the tropics, may be quite unsuited to the San Joaquin climate.

The medfly is one of about 4,000 species in the family Tephritidae, which thrive throughout the world in tropical, subtropical, and temperate regions. Over the eons, life in the different climatic zones has modified the various species for survival under specific conditions, and today the fruit flies fall into two groups—tropical and temperate. As a tropical species, the medfly is best adapted for life in tropical or subtropical climates, and life in temperate zones is likely to pose severe difficulties for it. To understand the nature of these problems, we must first understand the basic biology of these insects.

Although all fruit flies lay their eggs in living plant tissue, not all species prefer fruit. Some lay their eggs in flower heads, others insert them between the top and bottom layers of leaves, and still others deposit their eggs in vegetables. What they choose, of course, is what makes some of them economic pests. Choosing wild plants reduces most species to insignificance from our commercial standpoint, and choosing weeds actually elevates a few species to beneficial status when they help control their host plants.

The typical life history of a medfly proceeds from egg to larva to pupa to adult. The role of the egg is to package a new life, then protect it. The medfly's eggs have a tough outer coat, which envelops the embryo and stored nutrients. The eggs also contain an extra ingredient: a species of symbiotic bacteria that will live in the insect's gut for the rest of its life, contributing nutrients that do not exist naturally in the fly's diet. In return, the bacteria receive a protected existence. In some fruit fly species, this relationship has grown so entwined that the female actually has special structures to insure bacterial inoculation of her offspring. Her vaginal wall opens through a slit into the hindgut where the bacteria dwell. When an egg arrives from the ovaries, the vagina presses it against the opening, smearing it liberally with bacteria. The microorganisms then enter the egg through a tiny pore and invade the embryo, where they find special sacs devised for them by the embryo's developing gut.

Once the egg has been inoculated and the female fly has located a suitable fruit, she bores through the host's outer skin with the sharp, tubular ovipositor attached to the end of her abdomen. When she has penetrated deeply enough into the flesh, she forces an egg down through her ovipositor into the fruit. If medflies are abundant and have to compete by searching long and hard for unattacked fruit, they lay more eggs in

PICK UP A BARGAIN IN EUROPE.

AS LITTLE AS $112 A WEEK.

With the Hertz Affordable Europe program you'll get a great weekly rate on a fuel-efficient subcompact with unlimited free mileage.

Rent a car in Germany for example, for as little as $112. Or in Spain for as little as $119.* And get all the extras you expect from #1:

- Over 600 locations throughout Europe.
- No pre-payment. Hertz is the only major rental car company that doesn't require payment when you book.
- Rates guaranteed in local European currency.
- Hertz emergency service network on call all over Europe.

For further details and other European rates see your travel consultant, or call Hertz at 1-800-654-3001.

Hertz also has low weekly rates on larger cars. Cars must be reserved at least 14 days in advance. These rates are non-discountable and do not include gas or optional charges. *Rates are guaranteed in local European currency from April 1, 1982-March 31, 1983 (Germany $112/252 marks, Spain $119/11,550 pesetas). Dollar equivalents may fluctuate with changing exchange rates.

Hertz

AFFORDABLE EUROPE

HERTZ RENTS FORDS AND OTHER FINE CARS.

® REG U S PAT OFF © HERTZ SYSTEM INC 1982

L.L.Bean®

Summer Weight Slacks, $15.50

Cool and comfortable slacks for warm weather wear. Long wearing, lightweight poplin of 65% Dacron polyester, 35% combed cotton. Washable; no ironing required. Plain front style with two front and two rear pockets. Well tailored for a comfortable trim fit. Even waist sizes: 30 to 46. Inseams: 29", 31", 33". Three colors: Lt. Green. Blue. Tan.

Please Ship Postage Paid

____#1868W Lt. Green Summer Wgt. Slacks @ $15.50
____#1886W Blue Summer Wgt. Slacks @ $15.50
____#1867W Tan Summer Wgt. Slacks @ $15.50
Size________Inseam________
☐ Check Enclosed ☐ Master Card
☐ VISA ☐ American Express
Card No.________
Exp. Date________ ☐ SEND FREE CATALOG
Name________
Address________
City________
State________Zip________

L. L. Bean, Inc.
725 Casco St., Freeport, ME 04033

Monuments of Time

The Kawai piano is perfection obtained by the hand of time. Your investment in Kawai enhances with time.

Kawai America Corporation
24200 So. Vermont Ave., Harbor City, Calif. 90710

KAWAI

each oviposition wound than they would if the fly population were low and virgin fruits were common. Under natural conditions they lay from one to nine eggs per batch, but in crowded, experimental quarters, the females have been known to pack more than three hundred eggs into a single puncture.

When the embryo has completed growing inside the egg, it hatches and becomes a larva, or maggot. To emerge, the medfly larva claws a hole in the egg wall with two hooks normally concealed in its throat. (Later these hooks will be used to lacerate the fruit tissue.) Immediately after hatching, which takes about one minute, the tiny larva burrows deeper into the host's flesh and begins to eat. It thrives if it hatched in a plant conducive to its nutrition; however, only certain fruits and vegetables can provide the type of nutrition the medfly needs for optimal development. In poor hosts, the larvae develop more slowly and may not complete their growth. The medfly prefers just a handful of the 250-odd fruits and vegetables that it attacks; for example, it is rarely found in tomatoes or bell peppers.

A fruit may be unsupportive in a variety of ways. In the medfly's case, most citrus is a poor host. The female fly cannot reach the flesh inside because her ovipositor is too short, and the rind is a hostile environment for the eggs and young larvae. During maturation, citrus fruits produce oils that can poison the infant maggots. The fruits also produce gums that ooze into a newly cut egg wound and destroy the eggs even before they hatch. If the larvae survive these first lines of defense, they then face the task of cutting through nearly one-eighth of an inch of tough, elastic hide.

This is not to say these plant defenses are invulnerable; obviously they are not. Medflies periodically devastate such citrus crops as oranges and grapefruits in some regions, but this usually occurs under specific conditions. Either the fruit has matured so that the gums and oils no longer well up in the egg wounds or the flies repeatedly lay eggs in the same wounds. Successive larvae take up burrowing where their predecessors left off at death. Finally, a group of maggots pierces into the promised land and thrives there on flesh that is well suited to medfly nutrition.

Other fruits are poor hosts because the flesh itself is difficult to digest or because it lacks some vital nutrient. In these cases the larvae develop more slowly than they would in optimal fruits. Larval medflies normally take six to ten days to mature in their favorite host, ripe peaches, but need nineteen to twenty days in lemons.

Poor nutrition not only slows a larva's growth but can also lead to stunted, sterile adults. This need not happen in the first generation; it can take several cycles, with the adults gradually growing more effete until they lead short, barren lives. Medflies that grow in peaches or persimmons live longer than those that develop in figs, pears, or on artificial laboratory diets.

Many entomologists doubt the effectiveness of artificially reared male flies that are sterilized with cobalt radiation, then released to compete with vigorous wild males in mating prowess. The billions of sterile flies that state and federal agencies have released in the campaign to eradicate medflies are supposed to overwhelm the efforts of the wild, fertile flies. The idea is to release so many sterile males that they, and not the fertile wild males, are many times more likely to meet and to mate with wild females. After their first meeting, females try to avoid further copulations for at least ten days. If they have mated with sterile consorts, they will lay unfertilized eggs, which do not hatch. (A later mating with a fertile male would, however, fertilize subsequent eggs.) Theoretically, the medfly population would soon decline and die out for lack of fertile encounters. But all this depends explicitly on the competitive quality of the sterilized flies, which in turn depends on the quality of their diets.

Whatever plant a medfly maggot lives in is the obvious constituent of its diet. What the maggot actually eats, however, is determined by the symbiotic bacteria that live in an intestinal partnership with most, if not all, fruit fly species. These microorganisms have apparently been associated with fruit flies for millions of years. So important are these bacteria that many species of fruit flies have evolved sacs that open off the intestinal wall just to shelter their bacterial partners. The bacteria arrive in the fruit with the eggs and immediately go to work digesting the fruit for their own purposes. Their activity produces rot and it is this nutritive soup of breakdown products that the maggots devour. In the process of breaking down fruit tissue, the bacteria provide certain amino acids that the fruit itself does not contain and that larvae need in order to develop.

There are limits to this symbiotic relationship, however. Whether the bacteria cannot break down the tissues of all fruits or whether the fruit simply does not supply the necessary substances, the fact remains that the medfly is restricted in what fruits it can assimilate with efficiency. It does best on peaches, apricots, loquats, mangoes, guavas, and perhaps a few others. On all the other 250-odd hosts, it does considerably less well. To give some idea of how nutrition can affect the medfly population, peaches are reported to be from 20 to 200 times better than oranges in producing flies. This means that one fertile female medfly laying eggs in peaches would be able to produce as many offspring as up to 200 females laying eggs in oranges.

The typical medfly larva passes through three instars before reaching the pupal stage. After the second molt, it leaves the host plant to seek protection in the soil for the sedentary life stage that follows. For a creature with no legs or arms, it moves about remarkably well by using an unusual technique: jumping. The larva reaches back and with its mouth hooks grasps a special depression at the rear of its body. It then pulls back, arching its body. The hooks are then let go, releasing the tension and flipping the larva eight to nine inches into the air. By alternating a series of quick leaps with periods of rest, a healthy medfly larva can cover up to fifteen feet in about ten minutes.

Once the larva finds some soft soil or a fissure in the surface, it burrows several inches into the ground. Some soils, however, are so compacted that many larvae die attempting to burrow down for pupation, and many adults die just after hatching, when they try to dig back to the surface. The dry, hard soils of deserts are very difficult for fruit flies, as are heavy, moist soils like that of the San Joaquin Valley. These soil types are likely to restrict any medflies that might someday try to colonize these areas.

Burrowing down several inches from the surface, the larva forms a puparium, a type of cocoon in which it pupates. The pupal stage is one of physiological turbulence. The task of the pupa is to metamorphose—to develop from a legless, armless larva into a legged, winged adult. The pupa also has the problem of resisting the rigors of winter. In some species it does this by dropping its metabolism to a state of near-suspended animation, called diapause, in which it needs almost no oxygen and is impervious to severe weather on the surface.

This points up an important difference between the tropical and temper-

South Seas/Circle Pacific.
The Vikings invite you to meet the most interesting people on earth.

When winter sends shivers across the country, the Vikings sail from California to the sun-blessed Pacific.

To crystal lagoons and Polynesian vahines who wear the language of love in their hair. To high-spirited Aussies and their spectacular Opera House on Sydney Harbor. To Auckland, New Zealand. And island after exotic island.

On our Circle Pacific cruise, you'll also meet the Balinese, demure and ritualistic. The jewelers, tailors and antique dealers of Hong Kong. At Shanghai you'll visit the Chinese 2500 years after the Great Wall. And at cherry blossom time, the polite and proper Japanese.

Sail in World Class™ style—and in World Class company. Gracious European waiters serve you at a single seating in a sky-high, window-walled Dining Room. Smiling Scandinavian cabin stewardesses care for your needs.

Royal Viking Star, Norwegian in registry and spirit, sails roundtrip from San Francisco/Los Angeles, to South Seas, Jan. 13/14, 1983, 45 days. Or Circle Pacific Feb. 27/28, 1983, 69 days. (85/88 days to Florida/New York.) Contact your travel agent or Royal Viking Line, Dept. L-40, One Embarcadero Center, San Francisco, CA 94111.

ROYAL VIKING LINE

The 1982 Program

Stimulate your mind on a Questers nature tour. We search out the plants and animals, birds and flowers...and explore rain forests, mountains and tundra, seashores, lakes and swamps. There is ample time to photograph, absorb, reflect. Naturalist guides, small tour parties, first-class accommodations.

Worldwide Nature Tours 1982 Departures

The Americas

Everglades: 11 days, Apr. 8, Nov. 4 • **Hawaii:** 15 days, Feb. 14, Mar. 21, Oct. 10, Dec. 19 • **Alaska:** 17 days, June 12, 26, July 10, 24, Aug. 7 • **Pacific Northwest:** 12 days, June 20, Aug. 1 • **Superior Forest Canoe Trip:** 9 days, July 10, Aug. 14 • **Northwest Canada:** 16 days, July 2 • **Churchill:** 11 days, July 17 • **Newfoundland:** 16 days, June 13 • **Baja California:** 11 days, Apr. 16, Oct. 15 • **Southern Mexico:** 14 days, Feb. 14, Dec. 19 • **Costa Rica & Panama:** 16 days, Feb. 13, Nov. 20, Dec. 18 • **The Amazon:** 17 days, Jan. 17, May 9, July 4, Aug. 8, Oct. 10, Nov. 14 • **Galapagos:** 15 days, Jan. 28, Apr. 22, July 15, Aug. 5, Oct. 28 • **Peru:** 23 days, July 17, Nov. 6 • **Patagonia:** 21 days, Nov. 6 • **Trinidad & Tobago:** 11 days, Mar. 8, Nov. 8.

Europe

Iceland: 16 days, June 11, July 2, Aug. 6 • **Islands/Highlands of Scotland:** 21 days, May 27, July 15, Aug. 19 • **Switzerland:** 17 days, July 16, Aug. 13 • **Greece:** 19 days, Mar. 29, Sept. 20 • **Spain:** 20 days, Apr. 16, Sept. 3.

Asia and Africa

Israel: 16 days, Mar. 15, Oct. 18 • **The Himalayas:** 23 days, Mar. 18, Oct. 7 • **India:** 23 days, Jan. 30, Oct. 30, Nov. 27 • **Sri Lanka:** 18 days, Feb. 19, Nov. 19 • **Kenya:** 23 days, Feb. 4, July 22, Oct. 21 • **Zimbabwe & Botswana:** 19 days, July 8, Aug. 5.

Australasia

Australia & New Zealand: 30 days, Feb. 13, Oct. 2 • **New Zealand & the Milford Track:** 22 days, Feb. 12, Nov. 12 • **The Complete Australia:** 35 days, Sept. 3.

To learn more, write requesting the 1982 Directory of Worldwide Nature Tours. Indicate if you are interested in any particular tour and we will send the corresponding Detailed Itinerary.

QUESTERS
Questers Tours & Travel, Inc.
Dept. NH, 257 Park Avenue South
New York, NY 10010 • (212) 673-3120

AlaskA
TRAVEL ADVENTURES

Where Adventure Begins
We feature:

- Backcountry Adventures
- River Trips
- Inside Passage
- National Parks
- Fishing

Call for free brochure describing 50 adventures:

Toll Free: 800-227-8480
Northern Cal.: 415-329-9013
Southern Cal.: 213-859-3959

Alaska Travel Adventures
525 University Ave #610-AK
Palo Alto, CA 94301

NORTHWEST ORIENT
THE WORLD IS GOING OUR WAY!

Find out why people stay up all night reading our catalogue.

See page 31

© 1982 PCG, LTD

ate fruit flies. In temperate-zone species, each generation of pupae diapauses during the fall and winter. In the tropical species, the pupae do not diapause and the generations continue their life cycles without a seasonal disruption. This allows the tropical medfly and its relatives to reach astronomical numbers during favorable conditions as generation builds on generation. The temperate species, however, must quit for the year after a single generation.

Whether or not there is a diapause, the pupal stage is a vulnerable point in the medfly life cycle—the time the population suffers its worst losses. Buried in the soil, the pupa must endure damp cold. This factor is not as threatening to the diapausing temperate species, but damp, cold soil is deadly to the medfly and its tropical relatives, and few survive a winter season during which the soil temperature falls below 40°F for

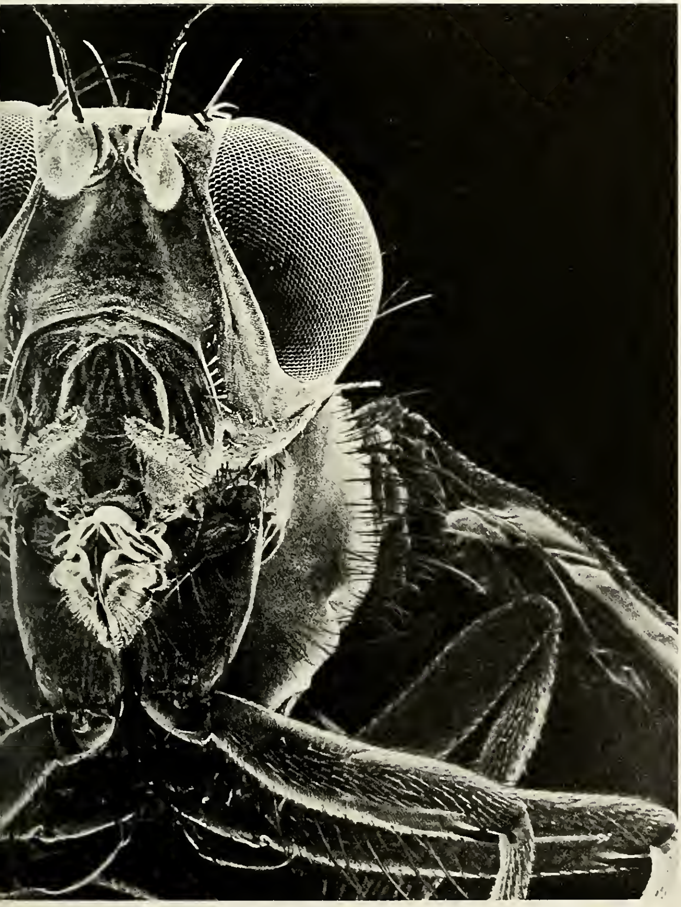
Female Mediterranean fruit fly X60

more than a few weeks. The pupa must also survive the ants, beetles, mites, nematodes, fungi, and bacteria that lurk in the soil. In sufficient numbers, these predators and parasites can suppress a medfly population.

Depending on soil temperatures, a medfly pupa completes its transformation to the adult stage in roughly one week to one month. By contracting its abdomen, the young fly forces fluid from its body cavity into its head. This causes the ptilinum, a saclike membrane that lies folded into a cavity inside the fly's head, to fill up like a balloon and bulge out from the insect's forehead. The ptilinum exerts so much hydraulic pressure that it bursts the puparium, and the fly wriggles free. By continuing to expand and contract its body and ptilinum, the fly works its way to the surface. The legs are not used for digging, yet medflies are capable of burrowing through more than eighteen inches of soil in their efforts to escape the earth.

Once free, the adult must take on the final tasks of the life cycle. It must eat, mate, find the best hosts possible for its offspring, and expand the range of its species. The adult is the stage of action. The first item on an adult's agenda is to eat. It needs energy, of course, but it also needs to acquire carbohydrates, as well as certain amino acids, vitamins, and minerals, before it is ready to mate and, in the female's case, generate eggs. The search for food depends on a system of sight and smell.

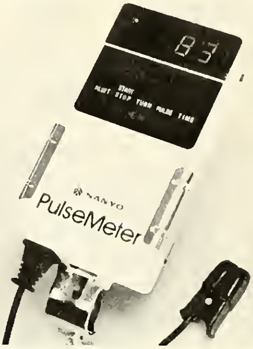
Because an insect is such a small creature, limits are imposed on its senses and the complexity of its nervous system. It cannot perceive the world in terms of all-inclusive pictures as a human can. A medfly cannot look at a peach tree and recognize it as such by its



David Scharf; Peter Arnold, Inc.

Don't Waste Your Exercise Time!

Update your exercise bike with a high quality Sanyo digital pulse meter.



Aerobic conditioning doesn't begin until you reach 60% of your maximum pulse rate.

This easy-to-use pulse meter allows you to exercise at your optimum pulse rate for maximum aerobic benefits.

- Features built-in stopwatch that displays elapsed exercise time.
- Attaches easily to your exercise bicycle, treadmill, or NordicTrack X-C Ski simulator.
- Bright L.E.D. readout of pulse, time, or pulse and time alternating.
- Sensor attaches to earlobe — not affected by arm motion as many pulse meters are — hands are free for reading, etc.
- Adds interest and motivation to exercising — instant knowledge of your pulse rate lets you know exactly how you're doing.
- Full one year warranty.

$110 Postpaid. Minn. residents add $5.50.

15 Day Return Privilege

Try it out — if not completely satisfied, return it for a full refund.

Call Toll Free for C.O.D. or Credit Card Orders, or Send Check:

PSI, 124 Columbia Ct., Chaska, MN. 55318
1-800-328-5888 Minnesota 612-448-6987
8:00 AM — 5:00 PM Monday through Friday

Share the Thrills of Exploring Outer Space!

$359.95 f.o.b. Hartford, Conn.

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

Criterion Manufacturing Co.
620 Oakwood Ave., W. Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION, MANUFACTURING CO., Dept. NH 114
620 Oakwood Avenue, W. Hartford, Conn. 06110
Please send your free Telescope Guide.
Name
Address
City State

Free--40 Pages of Peru

Faucett's Peru

Faucett's Peru is the ultimate guide to the land of the Andes Mountains, desert mysteries and the Amazon rain forest. All the facts, figures, photographs and details you'll need to plan your Peruvian adventure.

Faucett Peruvian Airlines
3095 N.W. 77th Avenue, Miami, Florida 33122
Or call 1-800-327-3368 and ask for Penny.
(In Florida, call 1-800-432-3239; Miami, 592-7536.)
NS-5/82
Name
Address
City State Zip

size, shape, cut of leaf, or bark texture. It must approach the tree and analyze it by a sequence of steps. The first step in finding food depends on the fly's vision. The insect eye cannot perceive fine details, but it does perceive certain colors. The medfly and other species tested all perceive yellow, which falls in the spectral band of wavelengths from 500 to 600 nanometers. This is the same band of wavelengths that foliage reflects most strongly and reflected light is what confers color to an object. Foliage reflects other wavelengths less strongly, with the additional light creating the impression we know as green. But the fruit fly eye responds primarily to the strongest component, yellow, and fruit flies find yellow irresistibly attractive. The attraction is so strong that a six- by eight- or eight- by ten-inch plaque painted yellow, coated with a thin layer of transparent adhesive, and hung in an orchard is still one of the best traps for food-foraging adults.

When the medfly approaches a fruit, smell becomes the insect's operating sense, and its olfactory sensors are primed to detect the odor of honeydew. Honeydew is a sticky fluid that certain sucking insects, such as aphids, whiteflies, mealybugs, and soft scales, excrete as a byproduct of feeding. They suck enormous quantities of sap from their host plants in order to collect sufficient quantities of certain nutrients. Consequently, they must excrete great volumes of carbohydrate solution, especially sugar, in the process of straining out the vital ingredients. The excess rains down on the surrounding foliage.

Honeydew then becomes a major food source for many insects, such as ants, lacewings, and countless others, including virtually all species of adult fruit flies. The flies seem to detect its odor, which probably derives from protein breakdown products. Bacteria attack honeydew almost as soon as it touches the leaves and twigs, and they break down its proteins, releasing ammonia-based scents. The fumes of ammonium acetate have been found to be strongly attractive to the medfly and are often used to increase the power of the yellow traps.

After these visual and olfactory tests, the fly lands to conduct a final test—that of taste. Medflies have taste receptors on their feet, and the sugars in honeydew trigger the strongest response. If sugar is detected, the fly extends its proboscis (a long, tubular mouth and tongue combined in one organ) and tastes the substance orally. Should the honeydew pass this final test, the fly commences to feed.

Under normal summer conditions, young medflies mature sexually in one to two weeks, and then the time for mating is at hand. Mating behavior is intimately related to the species' environment, however, and this relationship has selected for some major differences between the habits of temperate species such as the apple maggot (*Rhagoletis pomonella*) and the tropical medfly. The apple maggot almost always mates on the plant (an apple tree) whose fruit will feed its larvae. These flies probably utilize sight and smell for meeting and courting. They depend on movements of their brightly colored bodies and rakishly marked wings to conduct the entire affair. The limitations of fruit fly vision become clear whenever two members of different species meet or when two males encounter each other. With the same zeal as with a willing member of the opposite sex, one male will try to mount the other. These mistakes occur because the insect's compound eye is not capable of discriminating the finer nuances of shape, design, and detail that distinguish the sexes.

Male medflies are endowed with sex pheromones. These compounds attract virgin females, but usually hold little or no sway over mated females. The males, however, come to the odor of other males. The male attraction leads to the formation of leks. A lek is an area where males gather to attract and court females. As a strategy the lek is a way of pooling resources—in this case pheromones—because once settled into the leks, the new male adds his scent to the fumes already emanating from the others. This bolsters the signal, making the lek all the more attractive to virgin females.

When the female arrives, she may find three to six eligible males to choose from, each holding a territory on the underside of a leaf about twelve inches from his nearest neighbor. Courtship is brief and direct. The female walks toward the male, approaching head-on to within about half an inch. The male then begins to fan his wings in a slow rhythm, perhaps to blow some of his pheromone toward her or to send visual signs of his readiness. He also emits a high-pitched buzzing sound. After about five seconds, he vaults over the female's head, landing on her back. He grasps his mate and proceeds to copulate with her.

This type of courtship is performed only by males that engage virgin females; it is not used by males that attempt to mate with deflowered females. Because mated medfly females remain celibate for about ten days after mating, and because the proportion of virgins drops off as the season progresses, males turn their sexual energies toward unreceptive females. This has apparently led to the evolution of rape behavior.

Forced mating occurs during the time when few females answer the medfly male's chemical or visual calls, and it represents a drastic change in mating behavior. The male must abandon his mating station since the females will no longer come to him. He must go to where they are, on the fruit. Arriving on a peach, for example, he encounters a female in the act of laying eggs, with her ovipositor buried in the flesh of the fruit. He stalks her from behind, and while she labors to deposit eggs, he leaps onto her back and copulates with her.

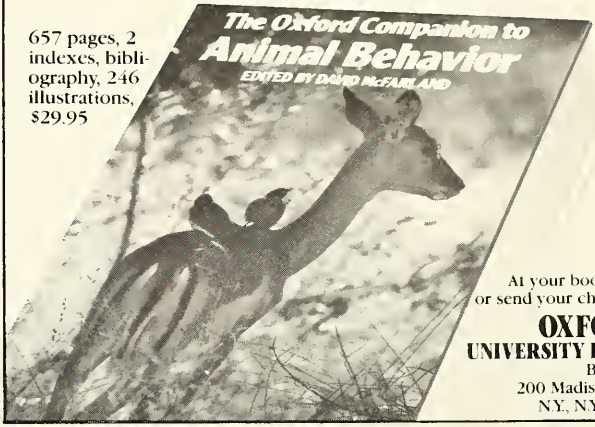
Research has shown that his sperms will take precedence over those from previous matings. This is possible because fruit fly eggs are fertilized just prior to being laid, not at copulation. The female stores the sperms in a sac, the spermatheca, and when an egg passes this sac on its way from the ovaries into the vagina, a few sperms are released. Whether the rapist's sperms succeed on the principle of "last one in, first one out," or whether his sperms actually push the others aside, is not known, but his sperms do prevail, assuring him extra offspring.

After laying her eggs, the female medfly performs one more reproductive act. She extends her ovipositor and drags it over the fruit's surface. This lays down a marking pheromone that may last a week or more. Its function is to eliminate the possibility that she will lay more eggs on the same site; it also drives off females of her own species that later may consider the same fruit as a site for their eggs. The week or so of protection gives her eggs time to hatch and to grow into maggots strong enough to outcompete later arrivals. The marking pheromone serves to distribute eggs evenly throughout a tree, resulting in larvae infesting most of the fruits.

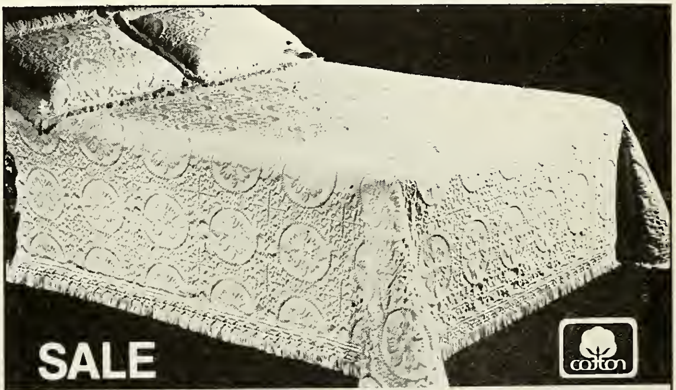
Aside from reproduction, the adult stage is responsible for another major task in the biology of the species: dispersal. The ability to disperse varies and is dependent on the species' life style, especially its reproductive strategies. The temperate fruit flies are relatively sedentary and disperse slowly. Adults rarely seem to fly more than a few miles from where they hatched. Some of the

Do you know... *How homing pigeons know where to go? Are birds monogamous? Do animals smile? Why do fish swim in schools?* The answers to these and scores of other fascinating questions about animal behavior are now at your fingertips in this new *Oxford Companion.* Over 200 alphabetical entries, each written by a specialist, cover everything from how animals choose their partners to how they learn what they must know to survive. "Excellent...anyone interested in animals can enjoy it." —Desmond Morris. "Splendid."—David Attenborough.

657 pages, 2 indexes, bibliography, 246 illustrations, $29.95



At your bookstore
or send your check to:
**OXFORD
UNIVERSITY PRESS**
Box 900
200 Madison Ave.
N.Y., N.Y. 10016



Beautiful
Early American
"COLONIAL LOFT"
BEDSPREADS

- Heavy—soft—durable
- 100% Quality Cotton
- Machine washable
- Choose white or natural
- Special Prices:

Twin 80 × 110, value $40...... only $32.95
Full 96 × 110, value $50....... only $39.95
Queen 102 × 120, value $65. only $47.95
King 120 × 120, value $75.... only $55.95
Sham (standard), value $15...only $11.95 ea
Add $2.50 per order for shipping

100% Natural Cotton, soft but ever so durable. A true legacy of Early America. This elegant woven bedspread is fully pre-shrunk and machine washable, with no ironing ever. Rich, full, all-cotton decorator fringe. **Guaranteed.** We ship fast.

Homespun Crafts • Dept. NH-4, Box 1776
Blacksburg, S.C. 29702
Gentlemen: Please rush ________ "Colonial Loft"
______ Size spreads & ______ shams, color ________
☐ Check ☐ M.O. enclosed ☐ M.C. ☐ Visa
Credit Card No. ________ Exp. Dt. ______
Name ________
Address ________
City ________ State ______ Zip ______
M/C, VISA orders—call toll free 24 hrs.: 800-438-7939, Ext. NH-4 or dial 800-458-3491, Ext. 87-C. CALL NOW!

tropical species, on the other hand, are peripatetic, with a remarkable ability to travel long distances. In addition, species such as the Mediterranean fruit fly, the Oriental fruit fly, the melon fruit fly, and the Caribbean fruit fly travel on a global scale as the passengers of human commerce. The medfly, in fact, deserves recognition as a symbol of colonialism. The first specimen noted by science was collected in 1817 on a ship in the Indian Ocean, where it probably hatched from fruit taken aboard at some African port. Within 150 years it has colonized most of the environments in which it is capable of surviving. Its distribution now ranges throughout the tropical, subtropical, and borderline temperate regions of the world, with the curious exception of Southeast Asia.

Fruit flies usually disperse just after hatching, during their preoviposition period, or later, when host fruits become scarce. In either case, the adults may fly long distances, and there are records of medflies, Oriental fruit flies, and melon fruit flies crossing twenty-five to forty miles of open water. Taken as part of the fly's life history, this dispersive behavior makes sense. Because the tropical species cannot diapause, they must be able to move away and hunt new hosts when the season advances and the current fruits drop. Travel is necessary in the tropics where one fruit or another is always in season, but may be miles apart.

Biologists are now trying to put this basic knowledge into a framework of medfly ecology. One area of research involves the way temperature affects the growth of populations. Ambient temperature rules almost all insects. Temperature determines when they hatch and when they die, when they hibernate and when they move about. On a more subtle level, temperature determines how large their populations grow in a season because temperature controls the individual's rate of maturation. The eggs, maggots, and pupae of the medfly cease to grow below about 50°F. The adults cease to mate and lay eggs below about 60°F. This gives a basis for predicting population growth, and as long ago as 1951, entomologists were predicting that the San Francisco area is not warm enough to grow more than about one and a half generations of medflies per year, which would not pose a serious threat to commercial agriculture. Fresno, in the San Joaquin Valley, was predicted to be too cold and damp in the winter and too hot and dry in the summer for serious medfly infestations.

Interspecific competition for the same niche is another factor in fruit fly distribution. A classic example occurred when the Oriental fruit fly invaded Hawaii and challenged the Mediterranean fruit fly, which was already established there. The medfly lost. It had invaded Hawaii about 1907 and so had some forty years to ensconce itself before the arrival of the Oriental fruit fly in the 1940s. Within a few years medflies could be found only at higher elevations, where they were superior to the Oriental fly because the latter could not tolerate the colder temperatures, or on coffee plantations, where medflies had the advantage of being able to attack coffee berries. Studies showed that under all other conditions, the Oriental fruit fly had a competitive advantage. Both species attacked the same kinds of fruit, but the Oriental flies sought the fresh oviposition wounds of the medflies and laid their eggs on top of the medfly eggs. The Oriental fruit fly eggs would hatch and mature, but the medfly's would die.

The reason may involve the symbiotic bacteria of the two species. This becomes clear when they are reared side by side on artificial food containing antibiotics that kill the symbiotes. The food is designed to provide all the nutrients that the bacteria would normally provide, so the larvae can grow without their presence. In these experiments, both species developed normally. Even though the precise cause is unknown, the Oriental fruit fly's competitive advantage does seem to involve its bacteria. Under natural conditions, the Oriental fly's bacteria may destroy the medfly's bacteria—this type of interaction is known to occur in other cases of competing symbiotes. On a larger scale, this competition between species may be the reason that the Mediterranean fruit fly has never taken hold in Southeast Asia and does not do well in many areas of Central America.

These ecological interactions also point the way to coping with the medfly. In California, for instance, the fly may be well established; it not only seems to be surviving in the face of the eradication plan but to be expanding its range. The feeling in entomological circles is that we had better resort to alternate means of control, and this means that we shall ultimately have to attack the weak points in the insect's biology.

A thorough study of its performance in the California environment must be mounted and tactics based on the results. A fairly strong approach along these lines is currently in progress. Some entomologists are spraying antibiotic baits over the medfly's host plants to kill its symbiotic bacteria. Some are studying the effects of such natural enemies as parasitic wasps and predatory spiders. Some are developing methods of using parasitic nematodes that live in the soil and attack the medfly larvae as they burrow down and the adults as they burrow back to the surface; these worms devour the fly from within and they are so hardy that they can be mixed with pesticides and sprayed over the soil in the same application. Others are aiming at developing better traps based on food-, mate-, and host-seeking behavior.

On the agricultural level, there is much that can be done to use the medfly's biology against it. Farmers can plant poor host crops, such as citrus fruits, instead of peaches. They can pick the fruit just as it ripens (medflies attack ripe or overripe hosts), and they can irrigate and plow the soil to devastate the pupal population underground.

Ultimately, all this biological insight will be integrated into an area-wide system of pest management. Using computers, the system will blend all the biological facts into a working model of an agro-ecosystem. Then the medfly will be viewed as just one of many insect populations sharing the same area, and the aim will be, not to exterminate the insect, but to manipulate the system so that the fly population is held below damaging levels.

Based on what we know about the medfly, the chances are excellent that this insect cannot thrive in the San Joaquin Valley, if it can survive at all. The summers are probably too hot and dry, the winters too damp and cold. Because this species of fruit fly cannot diapause, it cannot resist the severe weather conditions. It needs food and host plants available year-round, but farmers thoroughly harvest the valley each fall. Also, the San Joaquin soil is of an extremely dense, sticky, claylike consistency and would probably be a formidable barrier to larval burrowing. Unlike the coastal strip where the medfly now exists, the heartland of California agriculture promises to be an inhospitable land for them. Certainly, it is nothing like the tropical, coastal cradle that gave the medfly its genesis.

William H. Jordan, Jr., has been a free-lance writer since receiving his Ph.D. from the University of California, Berkeley. He authored "The Weevil and the Wasp," which appeared in the December 1979 issue of Natural History.

Imported by The Paddington Corporation, New York, N.Y. 34 Proof © 1981

WHAT'S A SPECIAL EVENING WITHOUT A LITTLE MAGIC?
BAILEYS
ORIGINAL IRISH CREAM
THE ORIGINAL IRISH CREAM
BAILEYS
ORIGINAL IRISH CREAM
THE ORIGINAL IRISH CREAM LIQUEUR

Baileys. A unique taste so silken, so full of character, only one word can describe it. Magic.

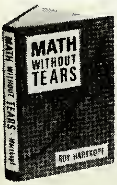
Perhaps it's that taste of magic that has made Baileys America's fastest growing liqueur.

BAILEYS. TASTE THE MAGIC.

BOOK HUNTING?
Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: BOOKS-ON-FILE
Box 195 Dept. 72
UNION CITY, NEW JERSEY 07087

SAFARIS • TREKS
EXPEDITIONS:
AFRICA
ASIA
S. AMERICA
U.S.A.
OVERSEAS ADVENTURE TRAVEL
1430 Mass. Ave. 302H, Cambridge, MA 02138
Telephone 617-876-0533

MATH WITHOUT TEARS
Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written.
Learn math in the comfort of your own home at minimum cost.
Order Now $11.95 plus $1.25 hdlg
EMERSON BOOKS, INC.
Dept. 468-G, Verplanck, NY 10596
10 Day Money Back Guarantee



The Wilderness Travel
World of Discovery

SUMMER/FALL NATURE TOURS to:
• CHINA • East Africa • Europe •
• Galapagos • Alaska • Australia •
• The Amazon • Ecuador • Peru •
Expert naturalist leaders Very small groups
Write for free illustrated catalog
WILDERNESS TRAVEL
1760-NB Solano Avenue, Berkeley, CA
(415) 524-5111 94707

BJORKLUNDEN
SEMINARS
Door County's Natural Splendor
June 20-26
The Season Matures
Aug. 22-28
What better place to enjoy these seminars on the natural wonders of Wisconsin's beautiful Door County than Bjorklunden, Lawrence University's 325-acre wooded estate on the shores of Lake Michigan? For a free brochure on these, and eight other wonderfully stimulating sessions, write Joseph A. Hopfensperger, Director, P.O. Box 92N, Baileys Harbor, WI 54202.

Where Do Comets Come From?

One theory is that these objects come from a far distant aggregation known as the Oort cloud

by Stephen P. Maran

A vast swarm of comets surrounds the sun and planets but at such great distances that none of the swarm can be seen. Yet astronomers are sure that the swarm, called the Oort cloud, is out there. A recent study using mathematical techniques in lieu of direct sightings suggests that there are six to ten times as many comets in the Oort cloud as previously believed. The study also indicates that comets from the Oort cloud may have bombarded the earth about 4 billion years ago.

Comets are difficult to study because a typical comet is visible for just a few weeks or months as it brightens when approaching the sun and again as it fades into invisibility when passing back out into space. It may not return for many centuries, if at all. An eighteenth-century English astronomer and instrument maker, George Adams, put it this way: "Little can be known where but little can be seen." In his book of astronomical essays, Adams noted that about 450 comets were thought to belong to the solar system, revolving around the sun in elliptical orbits. There are those who have claimed that some comets are visitors from interstellar space, observed on one-time visits while following random tracks past the sun. Modern analyses, however, indicate that all of the known comets probably are or were solar-system members.

After Adams's time, astronomers realized that there must be many more than 450 comets in the solar system, although the great majority of them are unseen. Further, several experts suspected the presence of a swarm of comets far from the sun and probably beyond the orbits of the known planets. The basis of our modern understanding of this subject was laid in 1950 by the Dutch astronomer Jan Oort, after whom the cloud is named. Oort, now in his eighties and still an active researcher, is recognized as one of the outstanding astronomers of our day.

In his brilliant 1950 study, Oort, although provided with suitable orbital data on only nineteen comets, determined that they are members of an enormous swarm whose properties can be estimated. He calculated that there are about 200 billion comets in the swarm, most of them located at distances of 50,000 to 150,000 astronomical units from the earth and sun. (One atronomical unit, or A.U., equals about 93 million miles, the average distance of the earth from the sun.) A typical comet in the Oort cloud, at a distance of 100,000 A.U., is so far off that a spaceship moving at the speed of light, if that were possible, would take more than nineteen months to reach it. Thus, the cloud is in a cold, dark region, far from the sun and in the outermost zone of the solar system.

A comet has just one permanent feature, its nucleus. The nucleus is a conglomerate of ice and frozen gases of various types, interspersed with particles of rock. For obvious reasons, the nucleus is often termed a "dirty snowball." As the snowball approaches the sun, solar radiation heats the frozen material, converting it to gases that stream off, blowing much rock dust along with them. This produces a huge atmosphere of gas and dust, sometimes 100,000 miles in diameter, that constitutes the coma, or "head," of the comet. Gas and dust from the coma stream away, thus forming the comet's tail. The head and tail reflect sunlight and produce some light of their own, making the comet visible. The material of the head and tail escapes into space and is lost to the comet forever. A simple calculation

NATURAL HISTORY MAGAZINE

SAVINGS CERTIFICATE

For *FOR THE SUM OF 9 DOLLARS*

This savings certificate saves you $9.00 off the single copy rate for 1 year on new subscriptions or renewals (12 beautiful and thought-provoking issues) of NATURAL HISTORY magazine, including membership in the American Museum of Natural History and all the benefits that go with it. As soon as we receive your order, we'll start your subscription and send your membership card.

☐ **YES,** Please send me a full year of Natural History at the low rate of $15 for 12 issues including Museum membership

☐ I want to save more. Send me 2 years of Natural History (24 issues) which includes membership for only $26 (a $22 savings off the single copy price).

☐ New ☐ Renewal

Send gift to: J547

Name ____________ (please print)
Address ____________
City ____________
State ________ Zip ________

☐ Payment enclosed ☐ Bill me later
Charge my ☐ Visa ☐ MasterCard
☐ American Express

Account number

Name ____________ (please print)
Address ____________
City ____________
State ________ Zip ________

Gift card to read ☐ 1 year $15 ☐ 2 years $26

Signature ____________

Moneyback guarantee if not satisfied.

Please add $5 per year for postage outside the USA. Payment must be included.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

POSTAGE WILL BE PAID BY ADDRESSEE

NATURAL HISTORY

P.O. Box 4200
Bergenfield, N.J. 07621

shows that even a great comet such as Halley's cannot endure this process indefinitely. Eventually the comet will run out of ice. Halley's comet will perish as a result of too many passes at the sun, as will many other observed comets. Accordingly, astronomers have long believed that there must be a source of "new comets," meaning those that are approaching the sun for the first time, but that may return again and again in the future until they too perish. Oort's 1950 study showed that the far-off swarm is the source of the new comets.

In the swarm, a multitude of cometary snowballs has been preserved from the solar heat in a cosmic deep freeze. The vast majority of the swarm never approach the sun closely enough to become visible from the earth and are never significantly heated. Oort calculated that gravitational pulls from passing stars disturb the swarm, occasionally sending a few of the comets into orbits that pass close enough to the sun to be heated and become visible. These, probably including Comet Kohoutek in 1973–74, are the new comets.

Sometimes, as a new comet passes the orbits of the planets, it is disturbed by the gravity of Jupiter or Saturn. The disturbance may throw the comet back out into the Oort cloud, may eject it from the solar system, or may shift the comet into a new and smaller orbit that confines it to the region of the planets. When still in the cloud, the comet may have taken a few million years to go around its huge orbit, never coming near the sun. But when trapped in the planetary region, like Halley's comet, the snowball will pass by the sun every century or two, if not more frequently, and the process of attrition by solar heating will be under way.

So much for the life of a comet. What about the life history of the Oort cloud? The comets in the cloud are widely thought to be pristine remnants of the solar nebula from which the sun and planets formed. Theorists differ, however, on where in the nebula the comets themselves formed. At first, one might suppose that since the billions of comets in the swarm are located far outside the orbits of the planets, that is where they were born. Although I share this view, I suspect it is a minority position among astronomers. According to some experts on the subject, as the solar nebula contracted, it would not have left enough material on its outskirts to make billions of comets far from the sun. Instead, these experts claim the comets were formed somewhere among the giant planets of the outer solar system—Jupiter, Saturn, Uranus, and Neptune—where much material would have been available. The recent *Voyager* probes of the Jupiter and Saturn moon systems revealed some icy surfaces on those moons, consistent with the idea that the cometary snowballs formed in their general vicinity.

The alternative point of view, that comets formed at the present location of the Oort cloud, has been advanced most convincingly by A.G.W. Cameron, a noted astrophysicist at the Center for Astrophysics in Cambridge, Massachusetts. According to his computations, as the contracting solar nebula assumed the form of a spinning disk, it spun off some satellite disks. The satellite disks, orbiting the solar nebula at large distances from the center, are identified by Cameron as the places where the comets were born.

As already mentioned, the problem in studying a typical comet is that it is only briefly and infrequently subject to observation. Consider then the difficulty

The World 'n General

GENERAL TOURS
takes you to
RUSSIA
For Under
$100 / DAY!*
including air fare
11 QUALITY TOURS
10-21 days

NOW YOU CAN SEE FOR YOURSELF!

- Finnair wide-body jets
- first class & deluxe hotels
- three meals a day
- full sightseeing
- all transportation in USSR
- theater performances
- American tour manager
- HAPPY TRAVEL gift
- many extras
- PLUS early booking PRICE GUARANTEE

*per person double occupancy from NY

ASTA USTOA

Member of the First Family of Travel

What A Way To Go!

GENERAL TOURS, INC.
711 THIRD AVE.
NY, NY 10017
212-687-7400 NH5/82

YES! I WANT TO SEE FOR MYSELF!
Please send my free copy of THE COMPLETE RUSSIA BOOK
name ____________
address ____________
____________ zip ______
my travel agent: ____________
____

CANADIAN CRUISE

THROUGH THE CANADIAN AND PACIFIC NORTHWEST'S SCENIC INLAND SEA

4 or 5 Nights From $636

Embark at Seattle for one of the world's great cruise adventures aboard the sparkling **Pacific Northwest Explorer.** Visit spectacular Princess Louisa Inlet. Explore Canada's Gulf Islands plus Victoria and Vancouver, B.C. Go ashore in charming communities of the San Juan Islands. For free brochure write:

EXPLORATION CRUISE LINES
1500 Metropolitan Park Bldg.
Seattle, WA 98101 Dept. NH-CN5

NAME
ADDRESS
CITY STATE ZIP

A Division of Alaska Tour and Marketing Services Inc

Enjoy the romance...
Send for a luxurious color catalogue of beautiful lingerie. French bra and bikini sets, lacy teddies, gowns, kimonos & much more.
Victoria's Secret
designer lingerie

Send $3 to Victoria's Secret, Dept. NH-05
Box 31442, San Francisco, CA 94131
Boutiques: San Francisco, Palo Alto & Cupertino

of investigating the Oort cloud, which is not observable at all. Far from the sun, the dirty snowballs in the cloud are simply invisible. About all the information we have comes from the calculated orbits of observed new comets.

The aphelion points on the orbits of the new comets, that is, the locations farthest from the sun, identify the regions of the Oort cloud from which these comets came. This tells us the distance of the cloud and also its shape. The aphelia are not confined to a thin disk but are located in all directions from the sun. This means that the Oort cloud is probably spherical. By contrast, the orbits of the planets *are* confined to a relatively thin, flat region within the spherical cloud.

To learn more than just the size and shape of the Oort cloud, astronomers have had to resort to mathematical exercises and especially to numerical experiments. In such experiments, the electronic computer is the investigator's laboratory. With the computer, we can simulate likely events in the history of the comet swarm and compress billions of years of natural phenomena into a few hours of computer time. Since the actual history of the Oort cloud is unknown, and is indeed the object of the experiment, the investigator simulates many possible events and computes the consequences of each. There are some big "ifs" in these simulations. If the number of simulations is sufficiently large, if the events simulated are representative of the wide variety of events that must have occurred over the history of the Oort cloud, and if the conditions under which the simulated events are assumed to occur are sufficiently accurate models of actual physical conditions in space, then the numerical experiment should yield meaningful results.

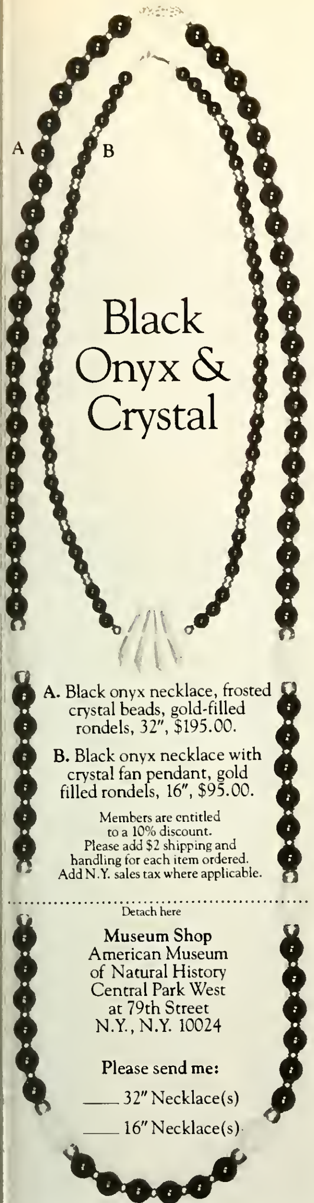
Some of the most interesting numerical experiments on the Oort cloud have been conducted using the Monte Carlo method. Named for the famous gambling resort in Monaco, this method is a technique for randomly sampling objects or events so as to avoid personal bias by the scientist. It is widely used in statistics, physics, and astronomy. Paul R. Weissman, a cometary astronomer at the Jet Propulsion Laboratory in Pasadena, California, is a leader in Monte Carlo studies of comets. In March 1981, Weissman reported to a conference on comets in Tucson, Arizona, that he had applied the Monte Carlo method to both scenarios for the origin of the Oort cloud: comets born near the outer planets and comets born in satellite disks of the solar nebula.

Weissman studied comets with a variety of initial perihelion and aphelion distances representative of comets originating among the giant planets and of comets that formed much farther from the sun. In each case, he investigated the subsequent travels of about ten thousand hypothetical comets that began with the identical perihelion and aphelion distances pertaining to that case. In the numerical experiments, the comets were tugged at by passing stars as they passed aphelion in their orbits. The tug direction for each comet was chosen at random by the Monte Carlo method. Some tugs by stars sent the comets farther out from the sun, some sent comets in toward the sun, some sent them on escape tracks into interstellar space. As comets neared the orbits of Jupiter and Saturn in their imaginary travels, Weissman's computer simulated the likely effects of encounters with those planets. As a result, some of the comets were trapped in smaller orbits than previously, like that of Halley's comet, so that they were lost to the Oort cloud, others were sent out into the cloud, and still others, thanks to gravitational boosts from Jupiter or Saturn, were sent on escape tracks.

The calculations on any single comet in the Weissman experiments are of almost no interest. After all, each comet considered was purely hypothetical and was tugged at randomly in a way that may not correspond to the specific history of any known comet. The bookkeeping on the overall set of calculations is what interests astronomers. From the initial assembly of tens of thousands of comets, how many were lost to the Oort cloud on escape trajectories, how many were lost by trapping in small orbits? Of the hypothetical comets formed near the outer planets, how many were sent into the Oort cloud? And how many were sent toward the sun?

The bookkeeping revealed an epoch during the first 500 million to one billion years of the solar system when a great many comets, taken from those formed among the outer planets (if such there were), were sent in toward the sun. Many of these interlopers from the outer solar system would have collided with the moon and the inner planets.

As nearly everyone knows, the moon is dotted with thousands of craters, mostly the scars of ancient impacts. Such craters must have covered the young earth as well, but they have since been eroded or buried by geological and



Black Onyx & Crystal

A. Black onyx necklace, frosted crystal beads, gold-filled rondels, 32", $195.00.

B. Black onyx necklace with crystal fan pendant, gold filled rondels, 16", $95.00.

Members are entitled to a 10% discount. Please add $2 shipping and handling for each item ordered. Add N.Y. sales tax where applicable.

Detach here

Museum Shop
American Museum
of Natural History
Central Park West
at 79th Street
N.Y., N.Y. 10024

Please send me:

_____ 32" Necklace(s)

_____ 16" Necklace(s)

I enclose a check payable to the American Museum of Natural History for $_________.

Charge to ☐ Visa ☐ MasterCharge

Account # Exp. date

Signature (if using credit card)

Name

Address

City State Zip

weather processes. *Mariner* space probes that photographed Mars and Mercury revealed that these planets are also marked with ancient impact craters. Venus, according to measurements with radar that penetrated its perpetual clouds, also has craters, although little is known of them. Most planetary geologists, therefore, have concluded that the moon and the inner planets were bombarded early in their history by a great many meteoroids. Now the Weissman study suggests that comets may have done it. The calculations of course involve hypothetical comets, but are applicable to the bombardment if comets did form among the outer planets.

Weissman also found that there are far more comets in the Oort cloud, perhaps 1.2 to 2 trillion of them, than estimated by Oort. He further concluded that stars are much less effective at ejecting comets from the cloud with a single tug than was previously supposed. Jupiter and Saturn, on the other hand, are quite effective at sending comets out on fast escape tracks. The stars, it seems, rob the solar system of comets by gradually moving them into larger and larger orbits through the sum total of numerous tugs. Eventually these orbits become so large that the comets are beyond the sun's zone of influence and subject to comparable or greater attraction by the gravity of other stars in our galaxy or by the gravitational force of the central mass of the galaxy. Thus, comets disturbed by the stars trickle out of the Oort cloud, rather than zooming away like those ejected by Jupiter and Saturn.

The question remains, Where did comets form? Curiously, the Monte Carlo calculations do not help. They show that whether formed among the outer planets or formed in satellite disks of the solar nebula, the comet swarm would gradually have reached its present location and shape through countless gentle tugs from the stars and planets. Weissman told me recently that the comets in the Oort cloud have been nudged so much that the present cloud "is a product of evolutionary circumstances and not of original conditions." Numerical experiments tell what may have happened to the unobservable cloud, but not how it began.

Stephen P. Maran is a senior staff scientist in the Laboratory for Astronomy and Solar Physics at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

The World 'n General

GENERAL TOURS

THE AFRICA EXPERTS TAKE YOU ON A

KENYA

ACTION SAFARI

15 days

from $2049* to $2249*

including air fare

NOBODY BUT NOBODY beats General Tours lowest prices for deluxe features.

- 9 full days on Safari including all meals
- round trip via Pan Am
- luxury accommodations
- two meals daily in Nairobi
- full sightseeing, incredible wildlife
- American Tour Manager

GRAB YOUR CAMERA AND AIM FOR ACTION!

YOUR KENYA EXPERTS GENERAL TOURS won the famous ASTA travel Trophy two consecutive years for outstanding development in African tourism.

*per person double occupancy from NY

ASTA American Society of Travel Agents USTOA AFRICA

Member of the First Family of Travel

What A Way To Go!

GENERAL TOURS, INC.
711 THIRD AVE.
NY,NY 10017
212-687-7400 NH5/82

YES! TAKE ME TO KENYA WITH THE AFRICAN EXPERTS Please send my free copy of KENYA ACTION SAFARI

name _______________

address _______________

_______________ zip _______

my travel agent: _______________

Celestial Events

by Thomas D. Nicholson

All Month All the planets were morning stars in March, just two months ago. Now, in May, when Uranus reaches opposition from the sun late in the month, all but two planets are evening stars. Only Venus and Neptune stay in the morning sky.

Venus remains quite bright and is well separated to the sun's right, but its orbit is low relative to the eastern horizon as it rises. The planet doesn't rise until about dawn, and stays low through twilight. Its brilliance should still help you find it until late twilight if the eastern horizon is clear. The waning crescent moon joins it on the mornings of the 19th and 20th.

Mars, Jupiter, and Saturn, all gathered in Virgo near its bright star Spica, are now well up in the southeast at dusk. Even though it is lowest of the group, Jupiter will probably be the first one you see because it is easily the brightest. Mars, still much brighter than Saturn and Spica, will become visible next, higher up the sky. Then, Saturn and Spica will show up between Jupiter and Mars, both about equal in brightness, with Saturn the higher of the two. By about 11:00 P.M., they will all be in the south, stretched out in a line from Jupiter on the left to Mars on the right. They set in the west at about dawn or a bit earlier. From the 3rd through the 6th, and again at the end of the month, the waxing gibbous moon will be among them, bright enough to hide the other stars and make Mars, Saturn, Spica, and Jupiter stand out more easily.

May 1: The eight-day-old waxing gibbous moon is very close to Regulus, the bright star of Leo, early this evening. The moon will move slowly away from Regulus (to its left) after dark.

May 3: The bright object to the east (left) of the moon tonight is Mars, with Saturn and Jupiter trailing in line to its left. The star close to and below Saturn is Spica, in Virgo.

May 4–5: The Eta Aquarid meteor shower, about twenty meteors per hour at best, reaches maximum during the day on the 4th. Unfortunately, the gibbous moon will brighten the sky during after-midnight hours both mornings, so meteor watching will probably not be good. The moon passes Saturn during the day on the 5th; Spica during the early evening. After dark, they will both appear beneath the moon, Saturn higher and toward the right. The brighter Jupiter and Mars are left and right, respectively.

May 7: Full moon, in Libra, to the right and above the bright stars of Scorpius' head.

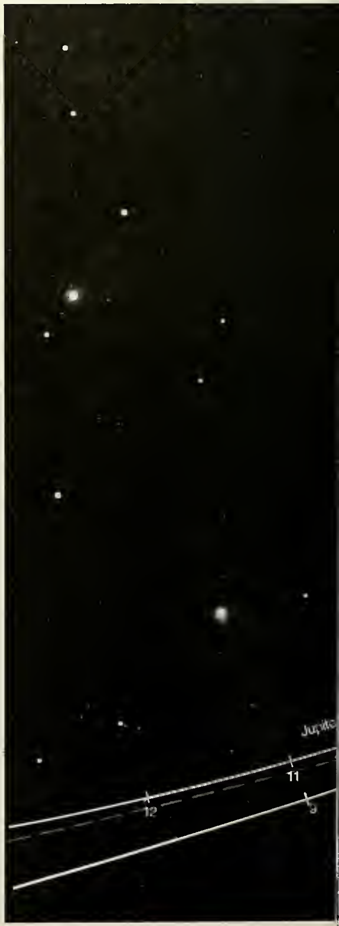
May 8–9: The moon is to the right and above Antares (in Scorpius) on the 8th, to the left and above on the 9th, passing above the star during the day on the 9th. Mercury is at its greatest distance to the east (left) of the sun (greatest easterly elongation) on the 9th. The inclination of its orbit to the horizon is favorable, but the elongation distance is much less than maximum because of the orientation of the ellipse relative to Earth. Observers with a clear horizon may be able to see the planet low in the western sky during late twilight for another week or so.

May 11: The waning gibbous moon is at apogee, farthest from the earth. It is in Sagittarius tonight, above the "teapot," when it rises after 11:00 P.M.

May 13: Mars has completed its retrograde loop among the stars opposite the sun. Now, reflecting the motions of the earth and the planet relative to one another, it resumes its "normal" easterly motion. This will be very evident during the next several weeks in the decreasing distance between Mars and Saturn and Mars and Spica.

May 16: Last-quarter moon.

May 19–20: The waning crescent moon passes Venus during the night on the 19th. On the mornings of both dates,



The bright star Spica (in Virgo) provides a reference to track the movements of Mars, Jupiter, and Saturn during 1982 (their positions are shown on the first day of each month beginning with April). All move westerly (retrograde, to the right) relative to Spica until Mars turns east on May 12–13, followed by Saturn on June 19, and Jupiter on June 28. Mars will accelerate in June, passing Saturn in early July, Spica in mid-month, and Jupiter in early August. The four objects (including Spica) will be closest about mid-July, when Mars, just above Spica, will be midway between Saturn, to its right, and Jupiter.

the moon and Venus will be an attractive pair in the east from about dawn until they fade in the brightening twilight. Watch the moon shift from west of Venus (to its right) on the morning of the 19th to its east (left) on the 20th.

May 22–24: New moon occurs late in the day on the 22nd, perigee (nearest the earth) less than 24 hours later. Expect exceptionally high tides on the 23rd and early on the 24th as the effect of perigee enhances the spring tide that comes with the new moon.

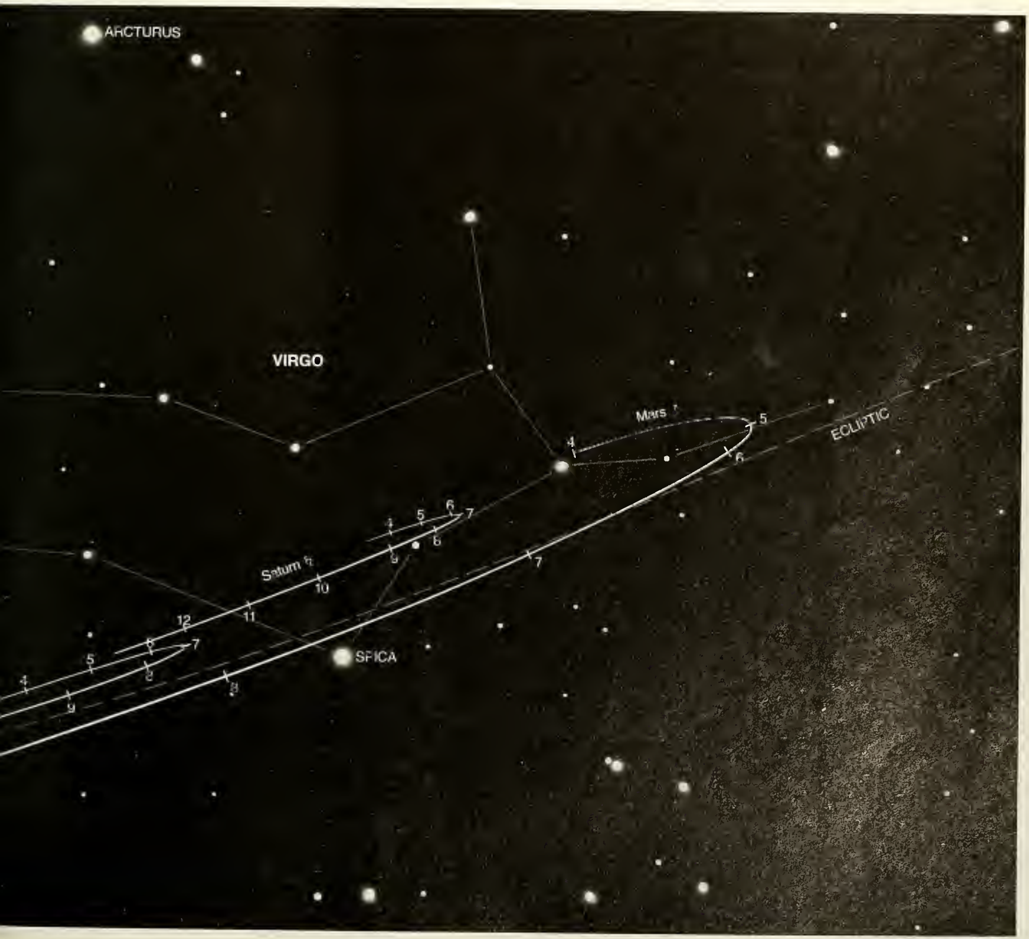
May 25–26: The young crescent moon may be visible during evening twilight on the 25th. It is in Gemini. You should certainly see it on the 26th, weather permitting, beneath and nearly in line with the "twin" stars, Pollux and Castor.

May 28: The crescent moon, almost at first-quarter, is near Regulus again, passing the star in the early evening. Even in a half hour, looking carefully, you will see the moon's easterly motion relative to Regulus as both move to the right toward the horizon.

May 29: First-quarter moon.

May 30–31: The gibbous moon passes Mars during the day on the 31st. It will be above Mars on both evenings, to the planet's west (right) on the 30th; east (left) of Mars on the 31st, with Saturn, Spica, and Jupiter farther to the east.

Editor's Note: The Sky Map in the April issue shows the evening constellations and stars for this month and gives the times for use.



Helmut Wimmer

Additional Reading

Jewelweed (p. 32)

Two books by Charles Darwin, written during his later years, are especially valuable as references to this issue's article on jewelweed. *The Effects of Cross and Self Fertilisation in the Vegetable Kingdom* (Philadelphia: Richard West, n.d., reprint of the 1889 edition, $20.00) reports the results of Darwin's many years of experiments on the generally deleterious effects of inbreeding in garden flowers, and *The Different Forms of Flowers on Plants of the Same Species* (New York: International Publication Service, 1969, reprint of the 1877 edition, $37.50) describes the phenomena of cleistogamy, heterostyly, and dioecy in great detail. *The Principles of Pollination Ecology*, by K. Faegi and L. van der Pijl (Toronto: Pergamon Press, 1979), is an attempt to formulate the general principles and techniques of the subject, designed for college teachers and students. This book is sometimes overly technical in language—*chiropterophily* is used for "bat pollination," for example—but it skillfully explains each of the many pollination systems, gives many case histories, and includes a sizable list of references. More humorous and much less technical is British orchidologist A. Bristow's *The Sex Life of Plants* (New York: Holt, Rinehart and Winston, 1978). Bristow relates the history of the discovery of sex in plants and discusses various pollination systems in anthropomorphic terms but conveys a good amount of biological information without resorting to technical jargon.

Haida Basketry (p. 40)

G.T. Emmon's "The Basketry of the Tlingit" (*Memoirs of the American Museum of Natural History*, vol. 3, part 2, July 1903, pp. 229–77) is an exceedingly detailed monograph with numerous plates and text illustrations. It describes the origin of basketry, its character in different tribes, the materials and preparation used in the craft, different weaves and shapes of baskets, and ornamentation and patterns. This publication may be difficult to locate, but it is a rich, classic work and still a major reference in the field. P. Drucker's *Indians of the Northwest Coast* (New York: McGraw-Hill Book Co., for the American Museum of Natural History, 1963) provides a broad overview of Northwest Coast Indian life, with chapters on economy, society, religion, ceremonials, art, and intercultural relationships. B. Holm's detailed *Northwest Coast Indian Art* (Seattle: University of Washington Press, 1965) covers the various uses of art, the importance of symbolic representation and abstraction, and also provides a structured analysis of color, form, texture, and other artistic elements. Photographs of various art objects make up more than half of *Art of the Northwest Coast Indians*, by R.B. Inverarity (Berkeley: University of California Press, 1950). The first section of the book briefly discusses the tribes, their social life, culture, and religion, and the general aspects of primitive art, as well as the main features of Northwest Coast Indian art. Inverarity explains the consistent, highly developed use of symbols and formulas and their incorporation into woodcarving, painting, weaving, appliqué, and other art forms.

Cheetahs (p. 50)

In October of 1964, while filming *Born Free*, J. Adamson adopted a nine-month-old cheetah cub, which she named Pippa. Both *The Spotted Sphinx* (New York: Harcourt, Brace and World, Inc., 1969), which introduces Pippa, and *Pippa's Challenge* (New York: Ballantine Books, 1973) are absorbing accounts of Adamson's experiences while sharing her life with Pippa and observing the animal in a natural environment. *Pippa's Challenge* picks up where *The Spotted Sphinx* left off: with Pippa's fourth litter of cubs, through Pippa's death, and the life of her cubs. Adamson was able to observe and photograph at close range cheetah mating habits never

"mmmm"

KAHLÚA Black Russian

The true classic:
an ounce of Kahlúa to two ounces of vodka on the rocks.

KAHLÚA White Russian

For a delicious change of taste, just add cream or milk.
And do send for the Kahlúa recipe book. Our compliments.
Maidstone Wine & Spirits Inc., P.O. Box 8925, Universal City, CA 91608.

© 1981 Kahlúa Imported Liqueur. 53 Proof.

before witnessed in the wild. R.L. Eaton's *The Cheetah* (New York: Van Nostrand Reinhold Co., 1974), a study of the biology, ecology, and behavior of this endangered species, includes a general description of the cheetah, its social organization and spacing, courtship and mating, aggressive behavior (including predatory and killing habits), management and behavior of wild cheetahs in captivity, and a final chapter on conservation. G.B. Schaller's *Serengeti* (New York: Alfred A. Knopf, 1972), a study of predators in this Tanzanian park, is a large-format book featuring many striking color photographs and a simple but informative text. A chapter is devoted to the cheetah (pp. 42–53) and its killing methods.

Avian Succession (p. 60)

The article in this issue is based on W.E. Lanyon's detailed study, "Breeding Birds and Old Field Succession on Fallow Long Island Farmland" (*Bulletin of the American Museum of Natural History*, vol. 168, article 1). This sixty-page monograph reports the results of research conducted during a twenty-year period (1958–77) on the Kalbfleisch Field Research Station in Huntington, Long Island. E.P. Odum's "Bird Populations of the Highlands (North Carolina) Plateau in Relation to Plant Succession and Avian Invasion" (*Ecology*, vol. 31, pp. 587–605) summarizes the findings of a study to determine the bird-population density of a high-altitude southern Appalachian region and to relate bird populations to plant succession.

Medflies (p. 70)

"Biology of Fruit Flies," by L.D. Christenson and R.H. Foote (*The Annual Review of Entomology*, vol. 5, pp. 171–92), a detailed report on the many types of fruit flies and their individual biologies, delineates the flies' life cycle, including reproduction, and also analyzes biological races, parasitism and symbiotics, movement, competition, and the possibilities for pest control. M.A. Bateman's "The Ecology of Fruit Flies" (*The Annual Review of Entomology*, vol. 17, pp. 493–518) emphasizes the importance of understanding, and consequently manipulating, certain aspects of the fly's life history and ecology in order to effectively manage populations. The article covers important environmental factors, such as light, food, natural enemies, and symbiotic microorganisms, as well as important aspects of behavior. E.F. Boller and R.J. Prokopy's "Bionomics and Management of *Rhagoletis*" (*The Annual Review of Entomology*, vol. 21, pp. 223–46), an extensive survey of the literature on *Rhagoletis*, is organized into three sections: the biology of individuals, the biology of populations, and management. The authors cite the paucity of information on *Rhagoletis* feeding, mating, and host selection but provide data on behavioral patterns that may lead to more effective control measures.

KAHLUA
IMPORTED
FROM SUNNY MEXICO
KAHLÚA
HECHO EN MEXICO
LICOR DE CAFÉ
COFFEE LIQUEUR
PRODUCT OF MEXICO
CARAMEL COLOR ADDED
KAHLUA, S. A.
FABRICA DE LICOR DE CAFE
PREPARED AND BOTTLED IN THE
IMPORTERS, LOS ANGELES, CALIFORNIA

IT ONLY LOOKS HARD...
... but it's really easy!

The secret's in our kits—imported from Europe—where these historic ship models are hand-crafted in walnut and rich woods by some of the finest model makers in the world. Solid brass, cast bronze and detailed wood fittings are used throughout. The hard work is done for you—most parts are *pre-cut*. Assembly is simple as you follow step-by-step instructions and large scale plans. Everything you need to complete is included, and we guarantee satisfaction.

Even if you have never built a ship before, send for our full-color catalog. See how easy it can be to build a museum quality model you will display with pride in home or office. Only $2.00.

Mail This Coupon Today!

MODEL EXPO, INC.
23 Just Road, Fairfield N.J. 07006 Dept. NH-52

Please send full-color catalog.$2.00 enclosed.

Name
Address
City State Zip

CELEBRATION

Asia's spectacular and colorful festival—the Perahera celebrated in honor of the Buddha in the jewel island of Sri Lanka. Join us on a tour for the Perahera and to see also splendid architecture and sculpture of medieval cities, wild life, the hill country, coastal villages and arts and crafts centers. Extensions to Kashmir, the Taj Mahal, Nepal and to South India's temple area are available.

For brochure write or call:

JOURNEYWORLD
155 East 55th Street, New York, NY 10022
Tel: (212) 752-8308

Wildlife Tours

Wildlife safaris Tanzania, Kenya, Botswana

Gorilla viewing Rwanda

Andes, Amazon and Galapagos islands

many other trips

Travel with the experts

Adventures International
4421-N Albert St., Oakland, CA
(415) 531-6564

Life and Death of the Mark Twain

In the spring of A.D. 550, seventy-four years after the Fall of Rome, a sequoia seed sprouted on a sunny hillside in western North America. By the time Muhammad was born, the tree had grown into a sturdy sapling. It was a lofty spire when the first stone was laid for Chartres Cathedral and a towering giant at the time of George Washington's inauguration.

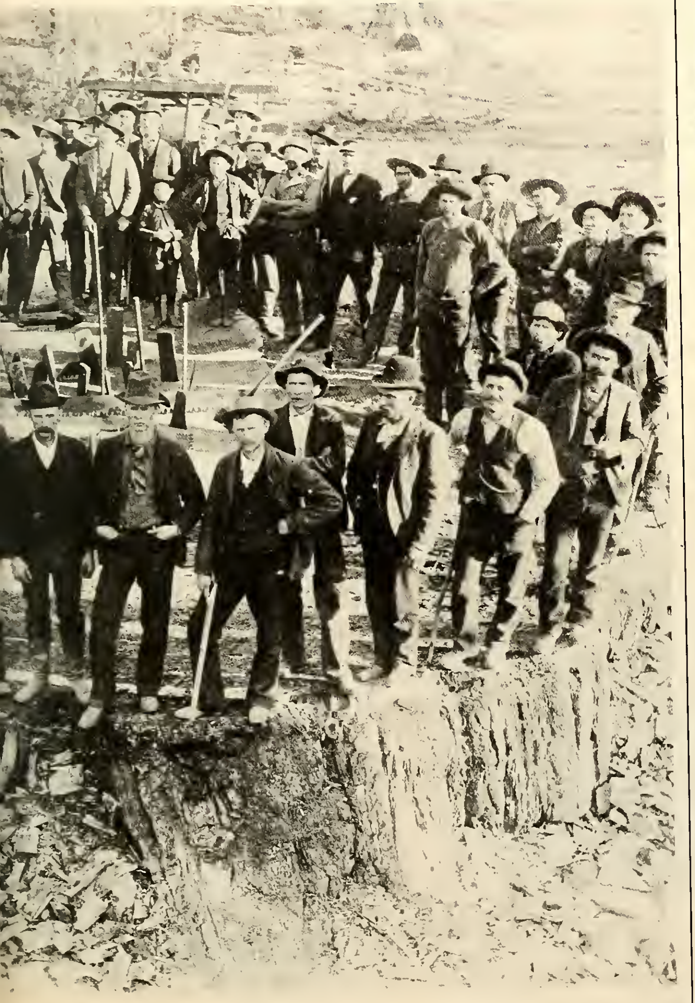
In the late nineteenth century, this sequoia, along with thousands of others then growing in Kings River Grove, Fresno County, the largest remaining stand of sequoias in California, became the property of A.D. Moore. Tourists and hunters had named many of the splendid trees in this grove, and this sequoia was christened "Mark Twain."

In 1891, Moore was approached by S.D. Dill of the American Museum of Natural History, who wanted a cross section of a sequoia to display in the Museum. Moore brought Dill to the upper slopes of the Kings River Grove and told him to pick out any tree he wanted; Moore would then have it cut down free of charge since he planned to cut down all the big trees anyway. Wandering about in the decimated grove, where many trees had already been felled, Dill spied the Mark Twain. It was a magnificent tree in excellent health, unscarred by lightning or fire, with a beautifully formed, symmetrical trunk entirely free of limbs for 150 feet. This, Dill decided, was the tree for the American Museum of Natural History.

The sequoia is the earth's largest organism, and the Mark Twain was actually just an average member of its species. It weighed close to two million pounds, and consisted of about 32,000 cubic feet of wood. At 1,341 years of age, it was still thousands of years younger than the oldest sequoias.

Moore took charge of felling the tree. His crew of lumberjacks took turns, two

After felling the Mark Twain in 1891, the lumberjacks posed on the stump.



AMNH

SOUTH AFRICA

A world in one country.
Expect the unexpected. Abundant varieties of fauna, flora and peoples. A rich land, unspoiled and beautiful.
For an unforgettable vacation experience, consult your travel agent or ask for your free color brochure, 'South Africa – Gateway to a Continent'.

South African
Tourist Corporation,
610 Fifth Avenue,
New York,
N.Y. 10020. NH-582
Tel. (212) 245-3720.
Telex 649535.
Name__________
Address__________

Where summer is four seasons long.

satour

at a time, chopping a great wedge in the side of the tree about six feet off the ground. At first they stood on a wooden platform, but soon the wedge was large enough so they could stand inside it. They cut two other wedges at right angles to the first one and a much steeper wedge on the far side in the direction the tree would topple. The chips from their ax strokes formed a pile more than six feet high. When they were finished, they had chopped out enough wood to have built two houses.

The wood of the sequoia is poor by commercial standards, being light, brittle, soft, and coarse grained. Because of their height and great weight, most sequoias shatter into hundreds of fragments when they strike the ground, further reducing their value as lumber. (Indeed, when a tree the size of the Mark Twain did not shatter, lumberjacks were obliged to dynamite it into fragments because the heavy trunk, more than five tons per foot, could not be handled otherwise.) The wood was used mainly for fence posts and house shingles, and the wasted wood (which could amount to more than half the tree) was carted away for firewood. One logger estimated the take from one tree to be about 3,000 fence posts, 650,000 shingles, and hundreds of cords of firewood.

The Mark Twain toppled in the fall of 1891, and while the upper part of the tree shattered on impact, most of the lower part was left intact. About twelve feet up the trunk, lumberjacks using a twenty-foot crosscut saw cut two pieces —one for the American Museum of Natural History and one for the British Museum (Natural History). The American Museum's section was 16½ feet in diameter (not counting the bark), 55 feet in circumference, and 4 feet thick; it weighed twenty tons and contained 11,500 board feet of lumber. The section was then cut into twelve pieces, each weighing about 3,300 pounds, hauled off the mountain, and loaded on railroad cars bound for New York.

For Vacationers from Coast to Coast

If you will be one of the more than 300 million visitors to America's national parks this year, Mammals of the National Parks *is designed especially for you.*

Written by Richard Van Gelder, one of the nation's leading authorities, this attractive, informative guide describes where to spot mammals in each of the forty-eight national parks and selected national monuments and concisely describes the more than sixty species found there. With sixteen full color photographs, thirty black and white ones, and a map of each individual park. $24.50 hardcover
$9.95 paperback

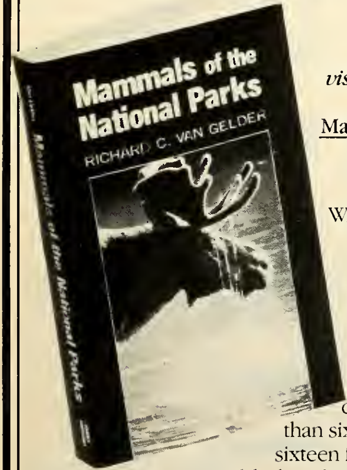
Also of interest

Common Plants of the Mid-Atlantic Coast
by Gene M. Silberhorn
illustrated by Mary Warinner

The beaches, dunes, and forests stretching from the Long Island Sound to South Carolina's barrier islands contain a host of unique plants. More than 100 individual plants are identified and illustrated in this invaluable guide for the beachcomer and amateur naturalist. Included are descriptions of the differing landscapes and a list of parks and refuges open to the public.
101 illustrations, location maps, plant keys
$17.50 hardcover, $7.95 paperback

Available at your bookstore, or from

THE JOHNS HOPKINS UNIVERSITY PRESS
Baltimore, Maryland 21218



The Mark Twain shattered upon striking the ground.

When Museum preparators reassembled the twelve pieces, they discovered two curious scars on the right-hand side of the trunk. In each scar there was a bullet, covered with five years of growth. Since the Kings River Gorge was a popular hunting ground, a hunter had probably used the tree for target practice.

Visitors to the Museum will find the Mark Twain in the Hall of North American Forests. Although seasoning over the years has reduced its weight by about ten tons, it is still an impressive monument to the sequoia, the largest living organism on earth.

Douglas J. Preston

AMNH

Sale! LAST TIME AT THIS PRICE!

Due to the soaring cost of GENUINE LEATHER, we cannot hold this price much longer. Order now!

The World's Most Comfortable Shoe!

Not ~~$50~~ Not ~~$25~~

Here Only $14.88

Genuine Leather

Smooth or Sueded

NOW! BLISSFUL COMFORT MORNING TO NIGHT! The closest thing to going barefoot! Handsomely-styled CosmoPedic shoes are the ultimate in comfort . . . and quality-crafted with features you'd expect to find in a **$50** or **$25** shoe! Luxurious genuine leather uppers in deer-tanned smooth or sueded leather are incredibly soft, yet amazingly shape-holding. The unique CosmoPedic arch support assures comfort thru long hours of standing or walking. A stitched collar prevents annoying chafing around the ankles. And for that walking-on-air feeling . . . comfort insoles and crepe soles pamper your feet from heel to toe! In Tan or Black smooth leather; Brown sueded leather . . . just **$14.88!**

TRY THEM AT OUR RISK! Return Within 14 Days for Money Back (except post. & hdlg.).

for Men and Women

Men's ½ sizes: 7 to 12, also 13
Width: C, D, E, EE, EEE
Women's ½ sizes: 5 to 10, also 11
Width: B, C, D, E, EE, EEE

Old Village Shop Hanover, PA 17331

SATISFACTION GUARANTEED OR MONEY BACK

OLD VILLAGE SHOP, Dept. VM-3714, 340 Poplar Street, Hanover, PA 17331

Sure, I'll try the world's most comfortable shoes. Please send me:

___prs. Men's Tan Leather (M242578B) Size/Width____
___prs. Men's Black Leather (M236802B) Size/Width____
___prs. Men's Brown Sueded (M242586B) Size/Width____
___prs. Women's Tan Leather (M203562B) Size/Width____
___prs. Women's Black Leather (M203687B) Size/Width____
___prs. Women's Brown Sueded (M223784B) Size/Width____

for just **$14.88** pr., plus $2.90 per pr. postage and handling. **SAVE MORE!** Order Two pair for just $28.99 plus $5.00 postage and handling.

CHARGE IT: ☐ VISA ☐ Diners' Club ☐ Carte Blanche ☐ American Express ☐ MasterCard
☐ Enclosed is $________
Acct. #__________ Exp. Date_____
PRINT NAME__________
ADDRESS__________
CITY______ STATE______ ZIP_____

Our policy is to process all orders promptly. Credit card orders are processed upon credit approval. Delays notified promptly. Shipment guaranteed within 60 days.

© H.H.I. Inc., 1982

Free Runaway Best-Seller.

KIAWAH
The Magazine For Island Vacationers
Volume II
Number I

Our free 30-page color book has introduced over 130,000 families to great escapes at Kiawah Island, near historic Charleston. Send for yours now and discover our new oceanfront Nicklaus golf course, plus 10 miles of beach, tennis, jeep safaris and superb Lowcountry cuisine. For reservations call us, or your travel agent.

Kiawah Island

Dept VMNH
P.O Box 12910
Charleston, S C 29412

Name__________
Address__________
City/State/Zip__________

Call TOLL FREE 1-800-845-2471.
In S C. 1-800-768-2121.

The Imilchil
Betrothal Fair
September 11-21, 1982

You are in a remote valley of the Atlas Mountains of Morocco. Milling around you, 10,000 people who have come here by camel, donkey or on foot to witness a thousand-year-old rite: the annual betrothal of young Berber women. Imilchil is the richly vivid culmination of a unique cultural venture which also takes you and a small group of fellow explorers to fortified settlements on the edge of the Sahara and to Africa's fabled Red City—Marrakech.

Slide show available. For more information write:

Cross Cultural Adventures
PO Box 3285, Arlington, VA 22203
"We show you the people around the sights"

An African Exploration
THROUGH SOUTH AND SOUTHERN AFRICA

Beyond the tourist tracks—face to face with the REAL Southern Africa of the 80's, in all its magnificence and complexity.

An opportunity to experience MORE than the spectacular countryside and superb fauna and flora. Come along with young professional people, who have a wealth of environmental and sociological experience, on a journey to the heart of the contrasts and contradictions that make this region so unique.

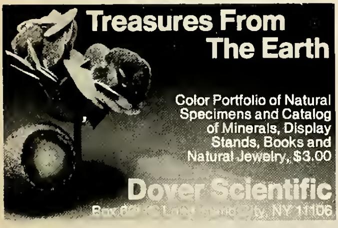
Paddle a dug-out through the Okavango Swamps, pony-trek in the Mountain Kingdom of Lesotho and wander along the flawless beaches of the Cape of Good Hope. Journey with us on this challenging adventure of the body, mind and spirit.

We'll show you Africa through African eyes

21 to 32 days from **$1250.** plus airfare

IBERIA

For full information, contact
AFRICAN EXPLORATIONS
852 West St., Annapolis, MD 21401
(301) 268-6808


Treasures From The Earth

Color Portfolio of Natural Specimens and Catalog of Minerals, Display Stands, Books and Natural Jewelry, $3.00

Dover Scientific
[illegible] NY 11106

HIMALAYA
TREKKING AND WILDERNESS EXPEDITIONS

Physical and cultural
quests for the spirited
adventurer in remote
CHINA, TIBET,
NEPAL, KASHMIR,
NEW ZEALAND,
JAPAN, and more.

For a beautiful TRAVEL PORTFOLIO detailing more than 20 unique trips around the world SEND $2 to 1802-N Cedar St., Berkeley, CA 94703.

Versions of the Traditional

Two free programs presented by the Education Department and the Touchstone Center will focus on Native American song and poetry. Both programs will be held in the People Center.

On Wednesday, May 5, at 7:00 P.M., John Bierhorst will read and talk about his translations of Aztec songs, with music by the Cantares Mexicanos. Bierhorst's translations of sixteenth-century Aztec songs will be published by Stanford University Press next year.

On Wednesday, May 19, at 7:00 P.M., Richard Lewis will read his versions of Navaho and Hopi poetry, done in collaboration with the late Laura Boulton. Diane Wolkstein will tell legends and myths of the Southwest Indians. For more information call the Education Department at (212) 873-1300, ext. 559.

In Search of Human Origins

The American Museum of Natural History, in cooperation with the L.S.B. Leakey Foundation, is presenting a major symposium, *Humans and Apes: Pathways in the Search for Human Origins.* Panelists Jane Goodall, Dian Fossey, and Birute Galdikas will join moderator Donald Johanson for this afternoon and evening program on Saturday, May 15, beginning at 2:30 P.M.

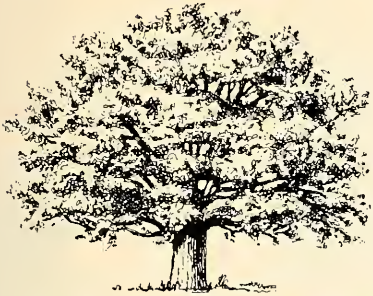
Jane Goodall has observed wild chimpanzees in Tanzania since 1960; Dian Fossey tracked free-ranging mountain gorillas in Rwanda from 1967 to 1981; and Birute Galdikas has followed the elusive orangutan in North Borneo since 1970. Donald Johanson is the discoverer of the Lucy fossil. The participants will use slides and films to illustrate primate behavior and will compare it with human behavior, looking for indications of common ancestry.

Tickets for the symposium must be reserved ahead of time. Please call the Membership Office at (212) 873-1327 for ticket prices and other information.

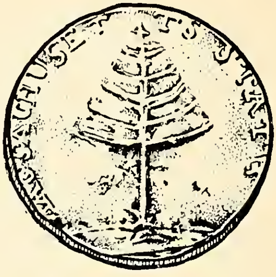
The IMAX movie To Fly *is currently being shown in the Museum's new Naturemax Theater. The theater's four-story screen and six-channel sound system enhance the film's special effects, which include drifting over Niagara Falls, soaring on a hang glider, looping with an aerobatic pilot, and speeding along in formation with the Navy's Blue Angels (incorrectly identified as an Air Force group in our February issue). For more information about Naturemax call (212) 496-0900.*

Conoco, Inc.

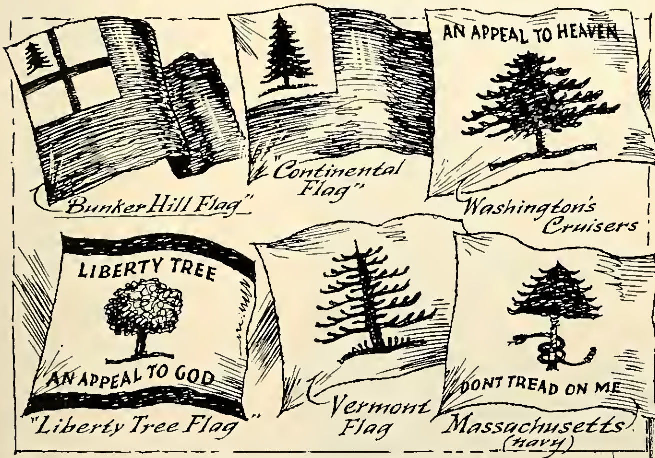
America and America's forests have grown up together.



In 1765, a group of merchants met under the "Liberty Tree" to discuss independence.


MASATHUSETS

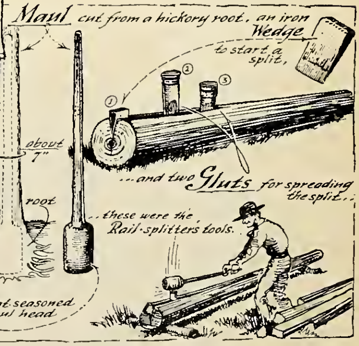
The pine tree shilling. It was America's first coin.


"Bunker Hill Flag"
"Continental Flag"
AN APPEAL TO HEAVEN
Washington's Cruisers
LIBERTY TREE
AN APPEAL TO GOD
"Liberty Tree Flag"
Vermont Flag
DONT TREAD ON ME
Massachusetts (navy)

America's first flags bore trees as their emblems.

© 1965 by Wilfred Funk, Inc., reprinted from REVERENCE FOR WOOD by Eric Sloane, by permission of Funk & Wagnalls Publishing Company, Inc., and Eric Sloane.

Wood gave our pioneers their furniture, medicine, fuel, homes, tools, weapons, toys.

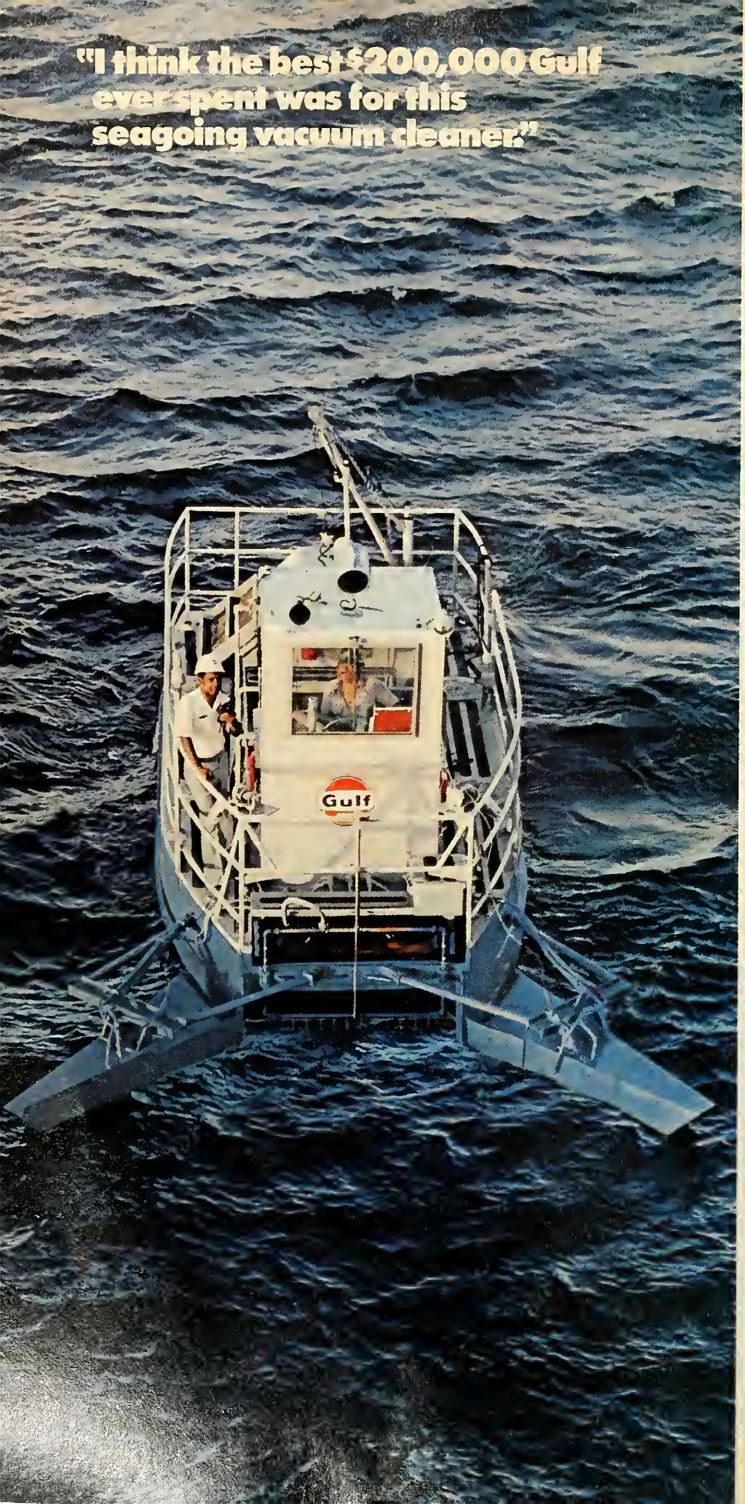

Maul cut from a hickory root. an iron Wedge to start a split,
① ② ③
about 7"
root
...and two Gluts for spreading the split...
...these were the Rail-splitter's tools.
heat seasoned maul head

Even our country's legends come from the forest.

Please be careful of fire. Because a country without its forests is a country without its future.

Ad Council

A Public Service of This Magazine & The Advertising Council


"I think the best $200,000 Gulf ever spent was for this seagoing vacuum cleaner."
Gulf

"In the last year or so, Gulf Oil has spent about $250 million to protect the environment around Gulf drilling rigs, mines and refineries," says Manuel Andino, Gulf's Utilities Director at San Juan, Puerto Rico.

"If any oil gets into the water, the Bay Skimmer can pick it up fast."

"But I'd say the Bay Skimmer was one of their best investments: $200,000 for a seagoing vacuum cleaner for San Juan Harbor.

"We've had a refinery here for 25 years. About 15 million barrels of Gulf crude oil and refined products pass through this port each year.

"That's a lot of oil, and if *any* of it gets into the water, the Bay Skimmer can pick it up fast. It was tailor-made for this job. We can go right through an oil slick, and a big belt in the bow simply lifts the oil off the water.

"The Bay Skimmer is just one detail in Gulf's overall investment in protecting the environment while keeping the oil flowing. Responsible energy management is a big challenge. It's expensive and it's complex. But it's a job worth doing, and I think we're doing it right."

Gulf

Gulf people: energy for tomorrow.

© Gulf Oil Corporation 1981

Respect Your Elders

Even the most sophisticated cultures have exploited the foods of the wild

by Raymond Sokolov

It was a very English way to discover a native American plant. We motored, as they say there, out of the city of Oxford and into lovely, legendary, literary farmland and estates. I had half a Sunday free, now that the intense and convivial proceedings of last September's Oxford symposium on national and regional food styles had come to an end. And so it was that, in the tow of a learned and energetic fellow symposiast, I came to lunch in a cottage on the grounds of Blenheim Palace and thence moved on to an unexpected and, you might say, fruitful encounter with the elderberry.

To be fair to myself (an obligation I shoulder with alacrity), I was not entirely innocent of the elder shrub and its many useful products. I had, for instance, a more than literary acquaintance with elderberry wine, having drunk that deep red, portlike decoction on a previous visit to Britain at a country pub that also sold wines made from cowslip and parsnip. And, like almost every American who has ever stepped outdoors, I had seen the common North American elder (*Sambucus canadensis*) in the wild.

Seeing, however, as any amateur botanizer knows, is not automatically equivalent to identification. Until that moment last fall when my companions fell hungrily on the blackish berries of several mature elders in an Oxfordshire garden, I had not ever bothered to distinguish the elder from the dozens of other berries one brushes against in the woods.

This time I could not fail to note the plant and give it all the respect it deserves. Taller than a man and filled with clusters of small berrylike fruits, these English elders are in fact a different species from our American elder. The European elder (*S. nigra*) has yellowish flowers and black fruit while ours has purplish black fruit and white flowers. Otherwise, similarity reigns. All elders are members of the Caprifoliaceae, or honeysuckle, family. They thrive in moist soil and grow tall for shrubs—in New York State, a fifteen-foot elder with a twenty-foot spread has been recorded. Elders are virtually disease free. They spread stoloniferously, by means of shoots (stolons) that bend to the ground or run along it and then take root, giving rise to new plants at their nodes.

This habit tends to create clumps of elders, which are pretty and also attract birds to your garden. Elder flowers, called elder blow, are themselves a sufficient reason to have these plants around. They grow in showy clusters, called cymes, broad, flat-topped, and edible as is. Indeed, as Karen Hess's new edition of a transcription of a seventeenth-century British cookery manuscript once in the possession of Martha Washington reminds us, pickled elder buds were once a popular element in boiled salads. And no less an authority than John Gerard recommended them for dropsy and weight reduction in his famous *Herball* (1597).

David Overcash, Bruce Coleman, Inc.

American Indians seem to have used elder blow (from western American species) for tea, muffins, and even batter-dipped fritters that include the whole cyme (see recipe). Elder tea (also brewed from the plant's bark, roots, berries, and compoundly pinnate, notched leaves) has a European background, too, and a medicinal reputation as a purgative and emetic. Modern health food enthusiasts endorse it as a source of vitamin C, a promoter of sweat, a diuretic, a soothing lotion for the eyes, and a natural repellent for insects and mice.

Yes, elderberries do take us back to yesteryear, to farmhouse science and an England that drank wine made from almost everything but grapes. *Beeton's Book of Household Management*, the mid-Victorian bible of domestic life published from 1859 to 1861 by Mrs. Isabella Beeton, contained a recipe for elder wine (see below). She wrote:

> The elder-berry is well-adapted for the production of wine; its juice contains a considerable portion of the principle necessary for a vigorous fermentation, and its beautiful color communicates a rich tint to the wine made from it. It is, however, deficient in sweetness, and therefore demands an addition of sugar. It is one of the very best of the genuine old English wines; and a cup of it mulled, just previous to retiring to bed on a winter night, is a thing to be "run for," as Cobbett would say: it is not, however, agreeable to every taste.

The berries' intense flavor, which Mrs. Beeton was referring to, had a deleterious effect on port in the eighteenth century, when Portuguese vintners used elderberries to improve the color of their wine.

Perhaps the most widespread commercial use of the elderberry in alcoholic beverages today is for Sambuca, the colorless sweet Italian liqueur. Few people realize that this "anisette" produced in the hinterland of Rome has an elder component. What gives this away is that *sambuco* is the Italian word for elder (derived from the Latin word that is also the scientific genus name for the plant). One Sambuca label I looked at recently did explain that the drink was made from berries, even went so far as to give a botanical description of the plant and reveal that it belonged to the honeysuckle family, but it never finally came out and said it was an elder. I surmise that this obvious piece of information got lost in the shuffle of translating the Sambuca label copy for American consumption.

Whether they know what it's made of or not, connoisseurs of Sambuca drink it *con le mosche*, "with flies." "Flies" are coffee beans. You drop them into your Sambuca and crunch while you sip, balancing the sweet with the bitter. To follow superstitious tradition, always dunk an odd number of beans. Even numbers bring bad luck.

Perhaps because of its association with superstition, folklore, and folk medicine in its more dramatic forms (purging and vomiting), the elder had a potent primitive aura surrounding it. Some people have thought it was the tree from which Christ's cross was cut. It has never been comfortably assimilated into modern, urban cookery, but it survives everywhere, as a reminder that even the most sophisticated cultures have exploited the foods of the wild, root and branch.

Not only Amerinds but Hungarians, those cooks of peerless elegance, make elder blow fritters. In *The Cuisine of Hungary*, George Lang prints a recipe that is barely different from the one Carolyn Niethammer collected for *American Indian Food and Lore*. If you should happen to open the *Larousse Gastronomique*, a classic encyclopedia of French cuisine, you will find a most curious entry for elder (*sureau*). In France, it says, the shrub is common everywhere, popular for tea and health drinks, and goes by several dialectal names (*smillet, saou, sambuc, hautbois*), a sure sign of its continuing association with primordial folk cookery. And what recipe does the august author of the *Larousse Gastronomique* recommend to such of his refined readers as may stumble upon an elder? Why he suggests that they boil the twigs.

The dish is called *moelle de sureau*, or "elder marrow." Young elder shoots have a soft pithy center. Children, and even adults, have been known to hollow them out and use them for whistles. French cooks, evidently, do the reverse. They cut away the outer layers, tie up the tender insides, and cook them like asparagus. The standard method calls for serving them cold with vinaigrette.

Such exotica may not tempt everyone. Indeed, for most people the primary interest of elders has always been the fruit, which has a distinct and seductive taste. Every general cookbook has at least one recipe for elderberry jam. Elderberries can also be dried and later stewed for pie fillings.

My companions in Oxfordshire were picking elderberry clusters to cook for a game sauce they wanted to serve in their London restaurant, Mijanou. I think I may borrow this idea next Thanksgiving and serve elderberry sauce instead of cranberry sauce, giving proper credit and announcing it as *Sauce sureau à l'instar de Mijanou.*

I will have to improvise a bit, though, since I neglected to get the restaurant's recipe. But the hard part will be to find elderberries this fall. It is too late to plant a couple of the richly fruiting available commercial cultivars (which must never be planted singly since they have to be cross-pollinated). Really, I ought to have a tangle of mature plants right out the door of the Hudson River Valley farmhouse where I now sit. But the previous occupant, a pious descendant of Huguenot settlers, did his best to extirpate all his elders to prevent his wife from making sinful wine. Elders are, however, notoriously difficult to squelch. I am about to institute a search for surviving shrubs and with luck I will find some. As so often, dinner begins not in the kitchen, but outside.

Raymond Sokolov's new book, Fading Feast *(Farrar, Straus and Giroux), is a collection of food columns that first appeared in* Natural History.

Elder Blow Fritters

Adapted from *American Indian Food and Lore*, by Carolyn Niethammer. Colliers (Macmillan)

1 cup flour
1 teapoon baking power
Dash of salt
2 eggs, separated
½ cup orange juice
Oil for deep frying
Elder blow in clumps on stems or just the flowers
Sugar

1. Sift together flour, baking powder, and salt.
2. Beat the egg yolks with the orange juice until well mixed. Then stir together with flour mixture.
3. Heat oil to 375 degrees.
4. Beat egg whites until stiff but not dry.
5. Fold the yolk-flour mixture from step 2 into the egg whites.
6. If you are using plain flowers, fold them into the batter and drop the mixture into the oil by tablespoons. Fry until golden brown, turning so as to cook uniformly.
7. If you are using clumps of flowers still on the stem, hold them by the stem end, dip in batter to coat them, and fry as above.

Yield: 20–25 fritters

Mrs. Beeton's Elder Wine

As reprinted in the 1969 facsimile edition of *Beeton's Book of Household Management*, published by Farrar, Straus and Giroux

Ingredients: To every 3 gallons of water allow 1 peck of elderberries; to every gallon of juice allow 3 lbs. of sugar, ½ oz. of ground ginger, 6 cloves, 1 lb. of good Turkey raisins; ¼ pint of brandy to every gallon of wine. To every 9 gallons of wine, 3 or 4 tablespoonfuls of fresh brewer's yeast.

Mode: Pour the water, quite boiling, on the elderberries, which should be picked from the stalks, and let these stand covered for 24 hours; then strain the whole through a sieve or a bag, breaking the fruit to express all the juice from it. Measure the liquor, and to every gallon allow the above proportion of sugar. Boil the juice and sugar with the ginger, cloves, and raisins for one hour, skimming the liquor the whole time; let it stand until milk-warm, then put it into a clean dry cask with 3 or 4 tablespoons of good fresh yeast to every 9 gallons of wine. Let it ferment for about a fortnight; then add the brandy, bung-up the cask, and let it stand some months before it is bottled, when it will be found excellent. A bunch of hops suspended to a string from the bung, some persons say, will preserve the wine good for several years. Elder wine is usually mulled, and served with sippets of toasted bread and a little grated nutmeg.

FLY TO THE POST OFFICE AND CULTIVATE A NEW INTEREST.

Right now, your Post Office is filled with fifty of the most beautiful birds and flowers in the country.

They're on the latest U.S. Commemorative stamps.

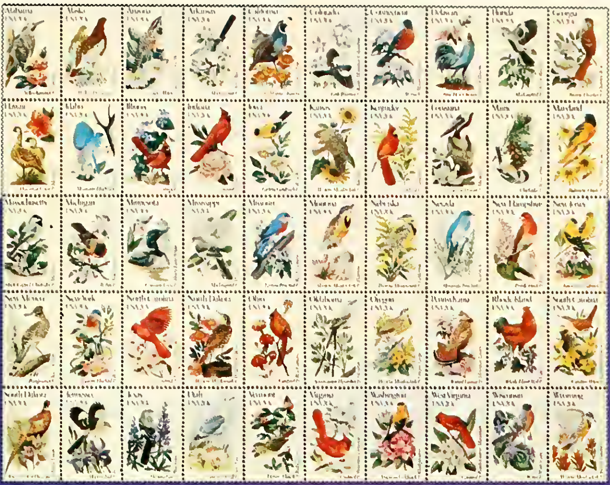
These stamps are a perfect way to start your collection or add to it. Because they are a collection in themselves.

Every state, every official flower and every official bird is represented on a different stamp.

Your new interest will bloom in fifty bright and colorful ways.

And when you add the other U.S. Commemoratives issued every few weeks, you'll discover the full beauty of America. Its history and heroes. It's an America you may never get to see on your own.

To get your collection off the ground, come to the Post Office and discover America's birds and flowers. Once you do, you'll find stamp collecting perfectly natural.



U.S. Postal Service

© USPS 1982

THE TASTE BEYOND 12-YEAR-OLD SCOTCH

The GLENLIVET
AGED 12 YEARS
AGED 12 YEARS
BOTTLED IN SCOTLAND
The GLENLIVET
12 YEARS OLD
Unblended all malt Scotch Whisky
Distilled and Bottled in Scotland
GEORGE & J. G. SMITH LIMITED
THE GLENLIVET DISTILLERY · GLENLIVET SCOTLAND
U.S. IMPORTERS
THE GLENLIVET DISTILLING COMPANY
NEW YORK, N.Y.
750 ML. (25.4 FL. OZ.) ·86 PROOF
ESTABLISHED 1824
12 YEARS OLD THE GLENLIVET SCOTCH WHISKY

Discover more.

Let your mature taste lead you from the finest premium Scotch on up to the most expensive 12-year-old Scotch in the world. The Glenlivet. The ultimate in Scotch.

Most premium Scotch is blended and depends on several whiskies for taste and smoothness.

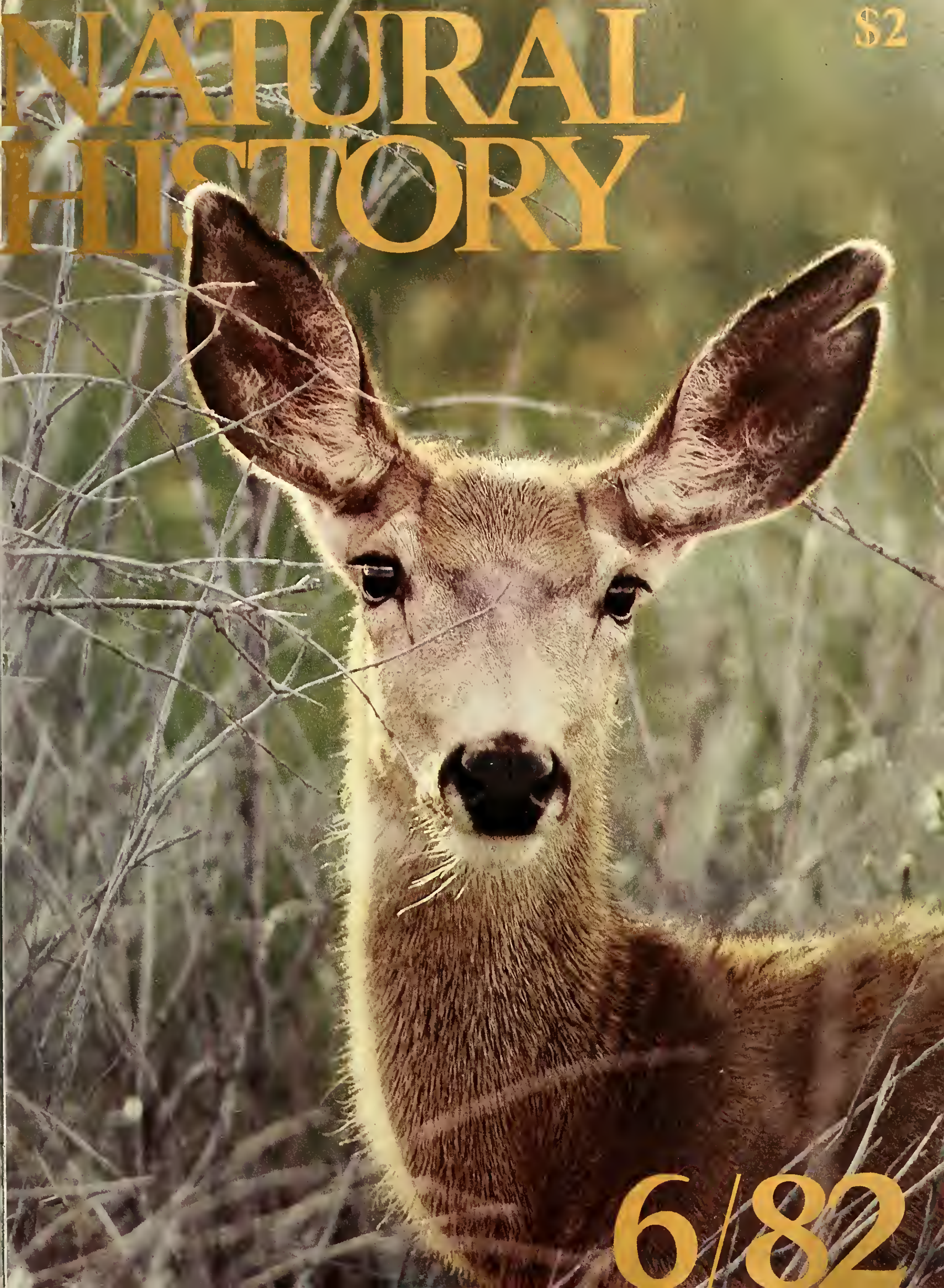
Yet the unblended character of The Glenlivet is noble enough to stand alone. In this distinctive Scotch whisky you'll experience an exceptional smoothness and full-bodied richness, unmatched in all other premium Scotch.

Try the taste beyond premium Scotch.

The Glenlivet
Unchanged since 1824.

NATURAL HISTORY

$2



6/82

"YOU CAN ALWAYS TRUST THE TASTE OF A BOLLA"

—Franco Bolla

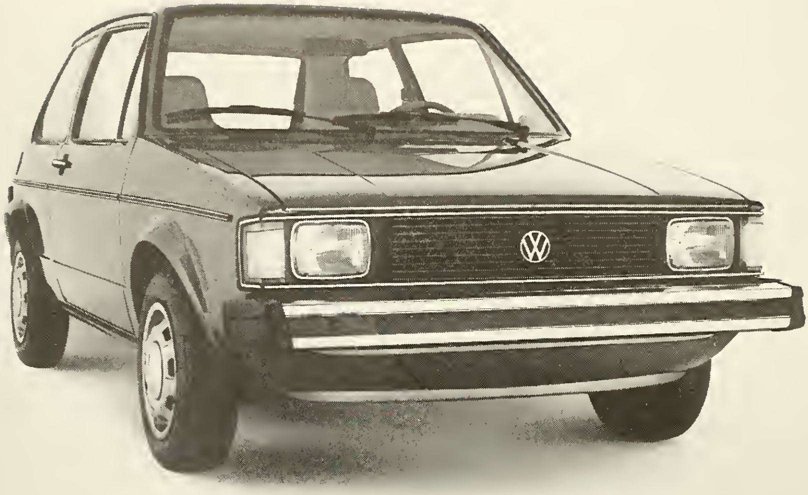
BOLLA
VALPOLICELLA
1978
QUALITA SUPERIORE
1977
BOLLA
QUALITA SUPERIORE
1979
NET CONTENTS 750 ML
ALCOHOL 11.5% BY VOLUME
SOAVE
CLASSICO · DENOMINAZIONE DI ORIGINE CONTROLLATA
BOLLA
ITALIAN DRY WHITE WINE
PRODUCED AND BOTTLED IN THE CLASSIC ZONE
SOAVE · ITALY
BY
FRABO S.P.A. · PRODUTTORI
VERONA · ITALY

"Why do so many people prefer the Bolla family of great wines?

"Taste. Not just exceptional taste, but exceptional taste, bottle after bottle. So whether you choose the full-flavored Valpolicella, the mellow Bardolino, the crisp, refreshing Soave or the light, dry Trebbiano, you won't be disappointed. No matter how many times you choose it. After all, when you're a Bolla, you don't let your friends down."

FROM THE BOLLA
FAMILY OF GREAT WINES.
IMPORTED BY THE JOS. GARNEAU CO., N.Y., N.Y.

(C) 1982 VOLKSWAGEN OF AMERICA



Is a cheaper car more expensive?

We readily admit that the Rabbit isn't the cheapest car you can buy.

Or is it?

Before you run out and buy a cheap car, ask yourself a few questions:

Does a cheap car come standard with fuel injection, front-wheel drive, and dual diagonal brakes?

Is a cheap car large enough to carry four large people without forced intimacy, yet agile enough to handle like a sports car?

Is a cheap car cheap to fix?

Or cheap when it's worth next to nothing at trade-in time?

When you take pencil and paper and tally the real cost of owning a Rabbit versus the real cost of owning something cheaper, you'll discover the awful truth about most cheap cars:

They're expensive.

Nothing else is a Volkswagen.

J&B. It whispers.
RARE
LENDED SCOTCH WHISK
100% SCOTCH WHISKIES
ENDED AND BOTTLED IN SCOTLAND BY
RINI & BROOKS
Street, London, Eng
RCHANTS TO THEIR LATE MAJESTIES
KING GEORGE III
ORGE IV
LLI IV
CTORIA
KING ED
KING GE
KING
J&B

98 T[illegible] P[illegible]ngton Corp NY

NATURAL HISTORY

Vol. 91, No. 6, June 1982

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director

Alan Ternes, Editor
Judith Friedman, Managing Editor
Thomas Page, Designer
Board of Editors: Carol Breslin,
Sally Lindsay, Frederick Hartmann,
Vittorio Maestro, Rebecca B. Finnell
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
E. Kay Danzig, Art Asst.
Kay Zakariasen, Picture Editor
Douglas J. Preston, Publications Editor
Annie R.C. Finch, Editorial Asst.
Lillian Berger
Editorial Advisers:
Malcolm Arth, James W. Atz,
Niles Eldredge, Kenneth L. Franklin,
E.Craig Morris, Norman Newell,
Thomas D. Nicholson, Martin Prinz,
Gerard Piel, Nina Root

David D. Ryus, Publisher
L. Thomas Kelly, Associate Publisher
Bradford D. Smith, Business Manager
Frederick E. Grossman, Production Mgr.
Debra Buck McCord, Asst. Production Mgr.
Ernestine Weindorf, Administrative Asst.
Elaine M. Callender, Advtg. Production Mgr.
Carol A. Midkiff

Cary Castle, Circulation Manager
Jeff Pieper, Assoc. Circulation Mgr.
Ramón E. Alvarez, Asst. Circulation Mgr.
Frank Stevens, Circulation Asst.

NATURAL HISTORY *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Subscriptions: $15.00 a year. In Canada and all other countries: $20.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.*

Copyright © 1982 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.*
Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225
Subscription Orders (800) 247-5470
(800) 532-1272 (in Iowa)

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

4 Authors

6 This View of Life *Stephen Jay Gould*
The Stinkstones of Oeningen

14 Free Enterprise in the Woods *Joseph L. Sax*
Through the years, the "vandalism of improvement" has threatened almost every major national park.

26 Sealed in Amber *George O. Poinar, Jr., photographs by Raymond A. Mendez*
A rare record of the daily lives of insects 25 million years ago.

---

33 Human Wants and Misused Lands *Erik Eckholm, illustrations by Jim Spanfeller*
A special Natural History *supplement looks at the world environment ten years after the landmark Stockholm Conference.*

---

50 How Mule Deer Mate in Texas *Thomas E. Kucera*
A good rule for a male who wants a harem is: stay in the open.

58 Additional Reading

60 Books in Review *Matt Cartmill*
An Ill-timed Modesty

64 Sky Reporter *Stephen P. Maran*
The Impossible Star

70 Celestial Events *Thomas D. Nicholson*

72 At the American Museum
The Journals of Ernest Thompson Seton

76 A Matter of Taste *Raymond Sokolov*
Hooked

Cover: *Whether or not this mule deer doe becomes part of a harem will depend on the courtship of dominant bucks and the habitat. Photograph by Larry Ditto; Tom Stack and Associates. Story on page 50.*

As a child, **George O. Poinar, Jr.**, was fascinated by amber. His enthusiasm took a serious, scientific turn when, as an entomologist trained in insect pathology, he began looking for fossil insects preserved in amber. His investigations turned up a number of instances of fossil symbiosis—the preserved remains of organisms that lived together symbiotically many millions of years ago. One exceptional specimen of Baltic amber proved to contain the oldest-known mummified material: the soft tissues of a fungus gnat so well preserved that cell nuclei and other intracellular structures could be observed. Poinar is a professor in the Department of Entomological Sciences at the University of California in Berkeley.

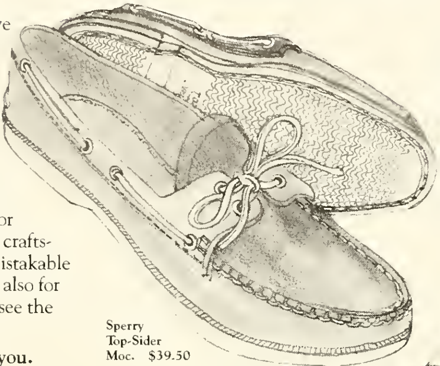
In his search for firsthand information on global environmental problems, **Erik Eckholm** has become a world traveler, visited numerous out-of-the-way places, and probably had every known shot. The author of three books and many pamphlets on environmental and health subjects, he has an advanced degree in international studies from Johns Hopkins University. Eckholm spent five years as a senior researcher at the Worldwatch Institute, in Washington, D.C., a nonprofit organization concerned with global problems. His article in this issue is adapted from his new book, *Down to Earth*, which he wrote while he was with the International Institute for Environment and Development, an advocacy organization with headquarters in London. Eckholm has appeared in *Natural History* three times before.

When **Thomas E. Kucera** heard that mule deer could be easily observed in Big Bend National Park, Texas, he went there to study the relationship between habitat and ungulate social behavior, and to test whether there was a connection between how the deer behaved and where they lived. He is currently at work on the status and conservation of large mammals in highland Bolivia, particularly vicuña and Andean deer. When he is not in the field, he is pursuing a Ph.D. at the School of Forestry and Resource Management, University of California at Berkeley.

The Sperry Top-Sider, the Stretch Short, and other "clothing that works" from Lands' End.

At Lands' End, we have a special affection for "clothing that works." Puts function first, fashion second.

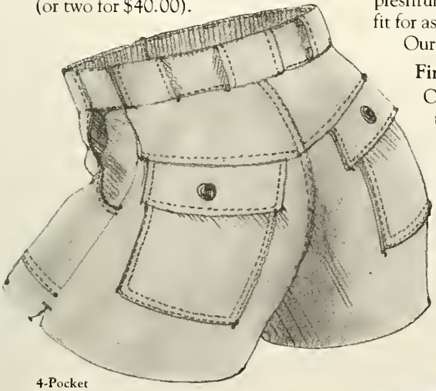
Consider, for example, that we offer nothing less in a deck shoe than the original Sperry Top-Sider Moc. Often imitated, but never equaled for its tenacious grip and sterling craftsmanship. At $39.50, an unmistakable value not only for sailors, but also for those of you who never even see the waterside of a lighthouse.



Sperry Top-Sider Moc. $39.50

Shorts that stretch with you.

Of equal interest is our new 4-Pocket Stretch Short. Unlike shorts that bind, pinch and chafe, our short gives you wonderful freedom of movement when you bend over an anchor line or clamber up a rock face. Reinforced at all stress points, and given tunnel belt loops that allow you to strap gear to your belt. Priced very sensibly, at just $21.00 (or two for $40.00).



4-Pocket Stretch Short. $21.00

And you should know about our "No Shrink" Rugby Jerseys. Not flimsy sport shirts, but authentically tough 100% cotton jerseys suited for rough 'n' tumble action. Gussetted under the arms for easy movement, and fitted with rubber buttons that prevent contact bruises. Best of all, they're preshrunk, so they'll keep their fine fit for as long as you wear them.

Our price is $32.

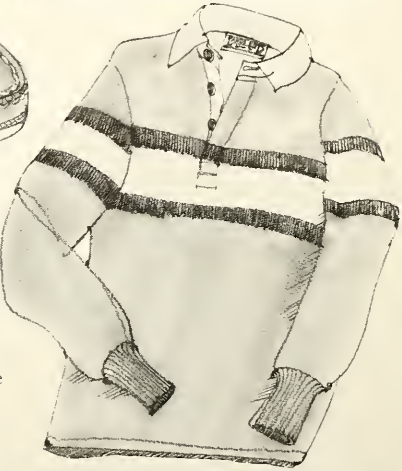
First quality, then price.

Our catalog is full of "clothing that works," sailing and sports accessories, our own famous soft luggage, and much more. Quality merchandise from around the world, at direct-to-you prices that represent very real values.

First, *quality*. Then, *price*. And always, always *service*.

Our guarantee: "*If you are not completely satisfied with any item you buy from us, at any time during your use of it, return it and we will refund your full purchase price.*"

If we're new to you, we don't ask that you trust us. Simply try us. Call toll-free 24 hours a day at 800-356-4444 (except Wisconsin call 608-935-2788).



"No Shrink" Rugby Shirt. $32.00

Or fill in the coupon, and let us send you a free copy of our latest Lands' End catalog.

☐ **Please send free 76-page catalog.**

Lands' End Dept. P-04
Dodgeville, WI 53533

Name ______________________

Address ______________________

City ______________________

State ____________ Zip ____________

Or call Toll-free

800-356-4444

(Except Wisconsin call 608-935-2788).

LANDS' END
DIRECT MERCHANTS

of fine wool and cotton sweaters, Oxford buttondown shirts, traditional dress clothing, snow wear, deck wear, original Lands' End soft luggage and a multitude of other quality goods from around the world.

The Stinkstones of Oeningen

Natural historian Georges Cuvier deserves special recognition for his advocacy of direct and patient observation

by Stephen Jay Gould

In his manifesto for a science of paleontology, Georges Cuvier compared our ignorance of geological time with our mastery of astronomical space. He wrote, in 1812, in the preliminary discourse to his great four-volume work on the bones of fossil vertebrates:

> Genius and science have burst the limits of space, and . . . have unveiled the mechanism of the universe. Would it not also be glorious for man to burst the limits of time. . . . Astronomers, no doubt, have advanced more rapidly than naturalists; and the present period, with respect to the theory of the earth, bears some resemblance to that in which some philosophers thought that the heavens were formed of polished stone, and that the moon was no larger than the Peloponnesus; but, after Anaxagoras, we have had our Copernicuses, and our Keplers, who pointed out the way to Newton; and why should not natural history also have one day its Newton? [I have followed the famous Jameson translation of 1817, which is as canonical for Cuvier's *Discours prêliminaire* as its namesake King James's is for Moses—hence some pleasant archaisms throughout, although I have checked the original in all cases for accuracy.]

Cuvier, an ambitious man, may have held personal hopes, though Darwin (whose earthly remains do lie next to Newton's in Westminster Abbey) has generally commandeered the proffered title. Still, Cuvier didn't do badly. His immediate successors, at least in France, usually referred to him as the Aristotle of biology.

The centenary of Darwin's death (April 1882) has prompted a round of celebrations throughout the world. But 1982 is also the sesquicentenary of Cuvier's demise (1769–1832), and our erstwhile Aristotle has attracted scant notice. Why has Cuvier, surely the greater giant in his own day, been eclipsed (at least in the public eye) during our own? In power of intellect, and range and breadth of output, Cuvier easily matched Darwin. He virtually founded the modern sciences of paleontology and comparative anatomy and produced some of the first (and most beautiful) geological maps. Moreover, and so unlike Darwin, he was a major public and political figure, a brilliant orator, and a high official in governments ranging from revolution to restoration. Charles Lyell, the great English geologist, visited Cuvier at the height of his influence and described the order and system that yielded such a prodigious output from a single man:

> I got into Cuvier's sanctum sanctorum yesterday, and it is truly characteristic of the man. In every part it displays that extraordinary power of methodising which is the grand secret of the prodigious feats which he performs annually without appearing to give himself the least trouble. . . . There is first the museum of natural history opposite his house, and admirably arranged by himself, then the anatomy museum connected with his dwelling. In the latter is a library disposed in a suite of rooms, each containing works on one subject. There is one where there are all the works on ornithology, in another room all on ichthyology, in another osteology, in another *law* books! etc., etc. . . . The ordinary studio contains no bookshelves. It is a longish room, comfortably furnished, lighted from above, with eleven desks to stand to, and two low tables, like a public office for so many clerks. But all is for the one man, who multiplies himself as author, and admitting no one into this room, moves as he finds necessary, or as fancy inclines him, from one occupation to another. Each desk is furnished with a complete establishment of inkstand, pens, etc. . . . There is a separate bell to several desks. The low tables are to sit to when he is tired. The collaborators are not numerous, but always chosen well. They save him every mechanical labour, find references, etc., are rarely admitted to the study, receive orders and speak not.

Cuvier has suffered primarily because posterity has deemed incorrect the two cardinal conclusions that motivated his work in biology and geology—his belief in the fixity of species and his catastrophism. Since being wrong is a primary intellectual sin when we judge the past by its approach to current wisdom, dubious motives must be ascribed to Cuvier. How else can one explain why such a brilliant man went so far astray? Cuvier then becomes an object lesson for aspiring scientists. Cuvier must have failed because he allowed prejudice to cloud objective truth. Conventional theology must have dictated both his creationism and the geological catastrophism that supposedly squeezed our earth into the Mosaic chronology. Consider this assessment of Cuvier presented by a leading modern textbook in geology:

> Cuvier believed that Noah's flood was universal and had prepared the earth for its present inhabitants. The Church was happy to have the support of such an eminent scientist, and there is no doubt that Cuvier's great reputation delayed the acceptance of the more reasonable views that ultimately prevailed.

I devote this essay to defending Cuvier (who ranks, in my judgment, with Darwin and Karl Ernst von Baer as the greatest of nineteenth-century natural historians). But I do not choose to do so in the usual manner of historians—by showing that Cuvier's beliefs were not rooted in irrational prejudice, but both arose from and advanced beyond the

GALAPAGOS

DARWIN'S ENCHANTED ISLANDS

The Galapagos Islands possess an untamed beauty and enchantment giving one the feeling of being on another planet. Although mere specs in the Pacific Ocean these volcanic islands have emerged as one of the most significant biological wonders on Earth. Due to their geographical isolation a unique and colorful array of plant and animal life has evolved representing a crossroads in evolution. During your expedition you will explore 11 of these mystical islands led by expert guides from the Darwin Research Center creating a tremendous learning experience in natural and geological history. Once visited you will never forget the aura of "Darwin's Enchanted Islands."

$1995 15 DAYS
(all inclusive from Miami)

1982 DEPARTURE DATES
September 11 October 9
November 13 December 4

For more information contact:

INTERNATIONAL EXPEDITIONS, INC.
Suite 104, 1776 Independence Court
Birmingham, Alabama 35216
205 870-5550
TOLL FREE 800 633-4734

ECUATORIANA

nuevo mundo

TO COLLECT ... TO ENJOY ... TO DISPLAY IN YOUR HOME

The Ducks of North America

William J. Koelpin, dean of American wood carvers, creates a definitive collection of hand-painted miniatures—the first ever to portray every species of duck in North America.

Thirty-six intricately detailed miniatures in all—available by subscription only.

Hand-painted duck decoys have a beauty and fascination all their own. Crafted according to traditional skills passed down from generation to generation, decoys today are admired and sought after by collectors as unique expressions of American folk art. Yet never has there been a collection portraying *all the species* of North America's ducks—until now.

For now, the dean of American wood carvers, William J. Koelpin, has accepted a commission from The Franklin Gallery to create just such a collection. A collection of *miniature decoys* portraying all of the 36 different kinds of wild ducks native to North America. Each decoy will be superbly detailed—hand-painted in its full natural colors. Together, they will form an unprecedented display of sporting art in a uniquely American collecting tradition.

Classics—by an acknowledged master

The art of William J. "Bill" Koelpin has won numerous awards and can be seen in major museums and private collections throughout the country. In 1974, Koelpin was chosen "Best in World" at the World Championship Wild Fowl Carving Competition in Salisbury, Maryland. He has been named "Master of the Guild" by the International Wood Carving Guild. And our nation's most prestigious wildlife museum—the Lehigh-Yawkey-Woodson Art Museum in Wausau, Wisconsin—has called him "one of America's premier artists."

Bill Koelpin's enormous talent—his artistic mastery, his accuracy and complete authenticity—will be in evidence throughout The Ducks of North America Miniature Decoy Collection.

Working directly in miniature, he has hand-carved an original master for each species of duck. From these master models, expert craftsmen take special molds, so incredibly detailed that they capture every line and curve of the sculptor's art. Each decoy in the collection is then crafted from these molds in a blend of resins and wood to create a perfect miniature. A work so lifelike, in every respect, that you will actually be able to see the *attitude* of the bird . . . the *texture* of its wing plumage . . . and the true-to-scale *proportion* of each species—from the majestic Mallard and King Eider to the compact Surf Scoter.

The rich colors and shadings of nature

To add to the life-like realism of the collection, each miniature decoy is then individually hand-painted in as many as twelve colors. These colors are carefully chosen and painstakingly applied to accurately define the rich hues and subtle shadings found in nature.

The iridescent green hood of the Mallard, for example. The steel-blue head and muted speckled breast of the Blue-winged Teal. And the brilliant plumage of the Wood Duck —a rainbow of purple, green, burgundy and bronze. Indeed, this individual hand painting of each miniature is the only way to achieve the *authenticity* that distinguishes the most desirable decoys. The result of all this

The Ducks of North America

MINIATURE DECOY COLLECTION

Please mail by June 30, 1982

The Franklin Gallery
Franklin Center, Pennsylvania 19091

Please enter my subscription for The Ducks of North America Miniature Decoy Collection by William J. Koelpin, consisting of 36 hand-painted miniature decoys, to be issued to me at the rate of one per month.

I understand that the original issue price is $27.50* for each miniature decoy and that this price will be guaranteed to me for the entire collection. The hardwood display rack will be sent to me at no additional charge.

I need send no money now. I will be billed for each decoy in advance of its shipment.

**Plus my state sales tax and $1. for shipping and handling.*

Signature ______________________________
ALL ORDERS ARE SUBJECT TO ACCEPTANCE.

Mr.
Mrs.
Miss ______________________________
PLEASE PRINT CLEARLY

Address ______________________________

City, State, Zip ______________________________

© 1982 FG

A

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

CA

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 1 FRANKLIN CENTER, PENNSYLVANIA

POSTAGE WILL BE PAID BY ADDRESSEE

THE FRANKLIN GALLERY
Franklin Center, Pennsylvania 19063

B

Miniature Decoy Collection

BY Wm. J. Koelpin

meticulous craftsmanship is a collection of 36 miniature decoys that represents a truly remarkable achievement. For each one is faithful to nature. Crafted with the precision and detail that would do credit to a full-size decoy—in a miniature that rests comfortably in the palm of your hand.

To complete the presentation, the base of each decoy will bear the signature of William J. Koelpin, together with the name of the waterfowl portrayed. And each decoy will be accompanied by a specially written commentary, describing the duck, its seasonal markings and its habitat.

A dramatic display to showcase the collection

So that these superb hand-painted miniatures may be displayed to their best advantage, a handsome display rack will be included as part of the collection.

This fine hardwood rack will provide a dramatic accent for the walls of a study, den or office. Its design allows ample room for the collection to be arranged in any of several ways.

Enter your subscription by June 30th

The Ducks of North America Miniature Decoy Collection will be crafted exclusively for subscribers. It is available only by direct subscription from The Franklin Gallery. It will not be sold through stores.

If you appreciate the beauty of nature's most spectacular waterfowl . . . and its expression in the uniquely American tradition of finely crafted decoys . . . this collection of hand-painted miniatures will provide you with rich and lasting satisfaction.

To subscribe, please reply by June 30, 1982.

MALLARD
Wm. J. Koelpin
© FG 1982

Decoys, at left, shown reduced. Average length is 3 inches.
The base of each decoy will bear the name of the species portrayed, the signature of the artist, and the copyright of The Franklin Gallery.

© 1982 FG

The Ducks of North America

MINIATURE DECOY COLLECTION

Please mail by June 30, 1982

The Franklin Gallery
Franklin Center, Pennsylvania 19091

Please enter my subscription for The Ducks of North America Miniature Decoy Collection by William J. Koelpin, consisting of 36 hand-painted miniature decoys, to be issued to me at the rate of one per month.

I understand that the original issue price is $27.50* for each miniature decoy and that this price will be guaranteed to me for the entire collection. The hardwood display rack will be sent to me at no additional charge.

I need send no money now. I will be billed for each decoy in advance of its shipment.

**Plus my state sales tax and $1. for shipping and handling.*

Signature ____________________

ALL ORDERS ARE SUBJECT TO ACCEPTANCE.

Mr.
Mrs.
Miss ____________________

PLEASE PRINT CLEARLY

Address ____________________

City, State, Zip ____________________

S6

Where in the world can you save money on a tropical vacation?

Now a vacation in peaceful Costa Rica is a better value because your dollar exchanges for twice as much as last year. Get away to our unspoiled beauty and year-round spring climate without blowing a bundle. For information write the Costa Rica Tourist Board, 200 S.E. First St., Miami, FL or call 800-327-7700, (800-432-7502 in FL), the airline that's happy to please you...LACSA.

LACSA
The Airline of Costa Rica

COSTA RICA
we have so much to share

Become a charter subscriber to

The Living Bird Quarterly

magazine when you join

The Laboratory of Ornithology

- features
- color photos
- paintings

$25 a year

not sold on any newsstand

Send your check today:
TLBQ 159 Sapsucker Woods Rd., Ithaca, New York 14850

social and scientific context of his own time. Nor (obviously) will I defend Cuvier's creationism or more than a sliver of his catastrophism. Instead, I want to argue that Cuvier used the very doctrines for which he stands condemned—creationism and catastrophism—as specific and highly fruitful research strategies for establishing the basis of modern geology—the stratigraphic record of fossils and its attendant long chronology for earth history. Some types of truth may require pursuit on the straight and narrow, but the pathways to scientific insight are as winding and complex as the human mind.

Cuvier is often portrayed as an armchair speculator because his conclusions are supposed to be wrong, and error is said to arise from aversion to hard data. In fact, he was a committed empiricist. He railed against the prevalent tradition in geology for constructing comprehensive "theories of the earth" with minimal attention to actual rocks and fossils. "Naturalists," he wrote, "seem to have scarcely any idea of the propriety of investigating facts before they construct their systems." (Cuvier correctly includes Hutton, subject of last month's column, among the system builders, although he confesses more sympathy for his Scottish colleague than for most of his ilk.)

Instead, Cuvier argues, we must seek some empirical criterion for unraveling the earth's history. But what shall it be? What has changed with sufficient regularity and magnitude to serve as a marker of time? Cuvier recognized that the lithology of rocks would not do, since limestones and shales look pretty much alike whether they occur at the tops or bottoms of stratigraphic sequences. What about the fossils entombed in rocks?

The idea that fossils reflect history is now so commonplace, we tend to regard it as an ancient truth. It was, however, a contentious issue in Cuvier's day, when debate centered on whether or not species could become extinct—for without extinction, all creatures are coeval and fossils cannot measure time (unless new forms keep accumulating and we can date rocks by first appearances. But a finite earth would seem to preclude continual addition with no subtraction).

Many of Cuvier's illustrious contemporaries (including Thomas Jefferson who, when not preoccupied with other matters, devoted a paper to the subject) argued strongly that extinction could not occur. Cuvier decided that the a priori (and often explicitly biblical) defenses of nonextinction were worthless and that the issue would have to be decided empirically. But previous studies of fossil vertebrates (his specialty) had been undertaken in the mindless way of mere collection. Fossils had been gathered primarily as curiosities—but scientists must *ask questions* and collect systematically in their light.

> Other naturalists, it is true, have studied the fossil remains of organized bodies; they have collected and represented them by thousands, and their works will certainly serve as a valuable storehouse of materials. But, considering these fossil plants and animals merely in themselves, instead of viewing them in their connection with the theory of the earth; or regarding their petrifactions . . . as mere curiosities, rather than historical documents . . . they have almost always neglected to investigate the general laws affecting their position, or the relation of the extraneous fossils with the strata in which they are found.

Cuvier then provides a two-page compendium of questions, an empiricist's *vade mecum* to combat the older speculative tradition.

> Are there certain animals and plants peculiar to certain strata and not found in others? What are the species that appear first in order, and those which succeed? Do these two kinds of species ever accompany one another? Are there alternations in their appearance; or, in other words, does the first species appear a second time, and does the second species then disappear?

But this research program for establishing a geological record cannot work unless extinction is a common fact of nature—and ancient creatures are therefore confined to rocks of definite and restricted ages. Cuvier's great four-volume work (*Recherches sur les ossemens fossiles*, "researches on fossil bones") is a long demonstration that fossil bones belong to lost worlds of extinct species.

Cuvier used the comparative anatomy of living vertebrates to assign his fossils to extinct species. Since fossils come in bits and pieces, a tooth here or a femur there, some method must be devised to reconstruct a whole from scrappy parts and to ascertain whether that whole still walks among the living. But what principles shall govern the reconstruction of wholes from parts? Can it be done at all? Cuvier recognized that he must study the anatomy of modern organisms—where we have unambiguous wholes—to learn how to interpret fragments of the past. The second paragraph of his essay presents this program for research:

> As an antiquary of a new order, I have been obliged to learn the art of deciphering and restoring these remains, of discovering and bringing together, in their primitive arrangement, the scattered and mutilated fragments of which they are composed. . . . I had . . . to prepare myself for these enquiries by others of a far more extensive kind, respecting the animals which still exist. Nothing, except an almost complete review of creation in its present state, could give a character of demonstration to the results of my investigations into its ancient state; but that review has afforded me, at the same time, a great body of rules and affinities which are no less satisfactorily demonstrated; and the whole animal kingdom has been subjected to new laws in consequence of this Essay on a small part of the theory of the earth.

As his cardinal rule for reconstruction, Cuvier devised a principle that he called "correlation of parts." Animals are exquisitely designed and integrated structures—perfect Newtonian machines of a sort. Each part implies the next, and a whole lies embodied in the implications of any fragment—a grand version of that immortal commentary on Ezekiel's vision, "the foot bone's connected to the ankle bone. . . . "

Cuvier presents the law of correlation as if it could be applied by reason alone, using the principles of animal mechanics:

> Every organized individual forms an entire system of its own, all the parts of which mutually correspond and concur. . . . Hence none of these separate parts can change their forms without a corresponding change on the other parts of the same animal, and consequently each of these parts, taken separately, indicates all the other parts to which it has belonged. . . . If the viscera of an animal are so organized as only to be fitted for the digestion of recent flesh, it is also requisite that the jaws should be constructed as to fit them for devouring prey; the claws must be constructed for seizing and tearing it to pieces; the teeth for cutting and dividing its flesh; the entire system of the limbs, or organs of motion, for pursuing and overtaking it; and the organs of sense, for discovering it at a distance. . . . Thus, commencing our investigation by a careful survey of any one bone by itself, a person who is sufficiently master of the laws of organic structure, may, as it were, reconstruct the whole animal to which that bone had belonged.

Cuvier's principle of correlation lies behind the popular myth that paleontologists can see an entire dinosaur in a single neck bone. (I believed this legend as a child and once despaired of entering my chosen profession because I could not imagine how I could ever obtain such arcane and wondrous knowledge.)

Enter the world of Questers nature tours.

Stimulate your mind on a Questers tour.

We search out the plants and animals, birds and flowers . . . and explore the rain forests, mountains and tundra, seashores, lakes and swamps. Tours are under the leadership of a naturalist, and range from 9 to 35 days. There is ample time to photograph, absorb, reflect. Tour parties are small, accommodations are first class, and all meals are included.

The current Directory of Worldwide Nature Tours describes tours to *In Africa*—Zimbabwe, Botswana, Kenya. *In Asia*—India, Nepal, Bhutan, Sri Lanka. *In Australasia*—New Zealand, Australia. *In Europe*—Iceland, Greece, Spain, Switzerland, Scotland. *In the Americas*—Everglades, Alaska, Baja California, Hawaii, Pacific Northwest, Costa Rica, Panama, Amazon, Patagonia, Galapagos.

Write today for a free copy of the Directory of Worldwide Nature Tours.

QUESTERS

Questers Tours & Travel, Inc.
Dept. NH, 257 Park Avenue South
New York, NY 10010 • (212) 673-3120

SEMINARS IN ORNITHOLOGY

The Laboratory of Ornithology
at Cornell University
Offers a Home Study Course
in Bird Biology

Inquire: HN, 159 Sapsucker Woods Road,
Ithaca, NY 14850

Cuvier's principle may well apply in the most general sense: if I find a jaw with weak peglike teeth, I do not expect to find the sharp claws of a carnivore on the accompanying legs. But a single tooth will not tell me how long the legs were, how sharp the claws, or even how many other teeth the jaw held. Animals are bundles of historical accidents, not perfect and predictable machines.

When a paleontologist does look at a single tooth and says, "Aha, a rhinoceros," he is not calculating through laws of physics, but simply making an empirical association: teeth of this peculiar form (and rhino teeth are distinctive) have never been found in any animal but a rhino. The single tooth implies a horn and a thick hide only because all rhinos share these characters, not because the deductive laws of organic structure declare their necessary connection. Cuvier, in fact, knew perfectly well that he operated by empirical association (and not by logical inference), although he regarded his observational method as an imperfect way station to a future rational morphology:

> As all these relative conformations are constant and regular, we may be assured that they depend upon some sufficient cause; and, since we are not acquainted with that cause, we must here supply the defect of theory by observation, and in this way lay down empirical rules on the subject, which are almost as certain as those deduced from rational principles, especially if established upon careful and repeated observation. Hence, any one who observes merely the print of a cloven hoof, may conclude that it has been left by a ruminant animal, and regard the conclusion as equally certain with any other in physics or in morals.

Since Cuvier didn't know the laws of rational morphology (we now suspect that they do not exist in the form he anticipated), he proceeded by his favorite method of empirical cataloging, amassed an enormous collection of vertebrate skeletons, and noted an invariant association of parts by repeated observation. He could then use his catalog of recent skeletons to decide whether fossils belong to extinct species. The earth, he argued, has been explored with sufficient care (for large terrestrial mammals at least) that fossil bones outside the range of modern skeletons must represent vanished species.

The four volumes of the 1812 treatise form a single long argument for the fact of extinction, the resultant utility of fossil vertebrates for ascertaining the relative ages of rocks, and the consequent antiquity of the earth. The introductory *Discours prêliminaire* sets out basic principles. In the first technical monograph, on mummified remains of the Egyptian ibis, Cuvier finds no difference between modern birds and fossils from the beginning of recorded history as then construed. The present creation therefore has considerable antiquity; if extinct species inhabited still earlier worlds, then the earth must be truly ancient. The next set of monographs discusses the detailed anatomy of large mammals found in the uppermost geological strata—Irish elks, woolly rhinos, and a variety of fossil elephants (mammoths and mastodons). They are similar to modern relatives, but the sizes and shapes of their fragmentary bones lie outside modern ranges and will not correlate with the normal skeletons of living forms (no modern deer could hold up the antlers of an Irish elk). Hence, extinction has occurred and life on earth has a history. The final monographs demonstrate that still older bones belonged to creatures even more unlike modern species. Life's history has a direction—and great antiquity if it has passed through so many cycles of creation and destruction.

Cuvier did not give an evolutionary interpretation to the direction that he discerned, for the very principle that he used to establish extinction—the correlation of parts—precluded evolution in his mind. If an animal's parts are so interdependent that each one implies the exact form of all others, then any change would require a complete remodeling of an entire body, and what process can accomplish such a complete and harmonious change all at once? The direction of life's history must reflect a sequence of creations (and subsequent extinctions), each more modern in character. (We would not deny Cuvier's inference today, but only his initial premise of tight and ubiquitous correlation. Evolution is mosaic in character, proceeding at different rates in different structures. An animal's parts are largely dissociable, thus permitting historical change to proceed.)

WHEN YOU WRITE TO NATURAL HISTORY

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance. You can use this form to tell us about a move or order a subscription.

Change of address—Attach your address label in the dotted area and fill in your new address below, clip and mail to Natural History Membership Services, P.O. Box 4300, Bergenfield, N.J. 07621.

Cut your old address label from magazine
wrapper and attach over this area.
Fill in your NEW address and mail to:
Natural History Magazine
Membership Services P.O. Box 4300
Bergenfield, N.J. 07621

PLEASE PRINT

Name ____________________

New Address ____________________

City __________ State ______ Zip ______

Thus, ironically, the incorrect premise that has sealed Cuvier's poor reputation today—his belief in the fixity of species—was the basis for his greatest contribution to human thought and hard-nosed empirical science: a proof that extinction grants life a rich history and the earth a great antiquity. (Readers must be tiring of my constant diatribes against modern pseudoscientific creationism, and one should heed Dryden's advice about not slaying the slain more than twice, but I cannot suppress the further irony that Cuvier's creationism—good science in his time—disproved, more than 150 years ago, the linchpin of modern fundamentalist creationism: an age of but a few thousand years for the earth.)

Cuvier's reputation took a second strike from his adherence to (and partial invention of) the geological theory of catastrophism, a complex doctrine of many parts, but focusing on the claim that geological change is concentrated in rare episodes of paroxysm on a global or nearly global scale: floods, fires, the rise of mountains, the cracking and foundering of continents—in short, all the components of traditional fire and brimstone. Cuvier, of course, linked his catastrophism to his theory of successive creations and extinctions by identifying geological paroxysms as the agent of faunal debacles.

A perverse reading of history had led to the usual claim—as in the textbook assessment of Cuvier cited earlier—that catastrophism was an antiscientific feint by a theological rear guard because it placed Noah's flood under the aegis of science, and justified a compression of earth history into the Mosaic chronology. Of course, if the earth is but a few thousand years old, then we can only account for its vast panoply of observed changes by telescoping them into a few episodes of worldwide destruction. But the converse does not hold: a claim that paroxysms sometimes engulf the earth dictates no conclusion about its age. The earth might be billions of years old, and its changes might still be concentrated in rare episodes of destruction.

Cuvier's eclipse is awash in irony, but no element of his denigration is more curiously unfair than the charge that his catastrophism reflects a theological compromise with his scientific ideals. In the great debates of early-nineteenth-century geology, catastrophists followed the stereotypical method of objective science—empirical literalism. They believed what they saw, interpolated nothing, and read the record of the rocks exactly as it appeared in outcrop. This record, read literally, is one of discontinuity and abrupt transition: faunas disappear, terrestrial rocks lie under marine rocks with no recorded transitional environments between, horizontal sediments overlie twisted and fractured strata of an earlier age. Uniformitarians, the traditional opponents of catastrophism, did not triumph because they read the record more objectively. Rather, uniformitarians, like Lyell and Darwin, advocated a more subtle and *less* empirical method: use reason and inference to supply the missing information that imperfect evidence cannot record. The literal record is discontinuous, but gradual change lies in the missing transitions. To cite Lyell's thought experiment: if Vesuvius erupted again and buried a modern Italian town directly atop Pompeii, would the abrupt transition from Latin to Italian, or clay tablets to television, record a true historical jump or two thousand years of missing data? I am no partisan of gradual change, but I do support the historical method of Lyell and Darwin. Raw empirical literalism will not adequately map a complex and imperfect world. Still, it seems unjust that catastrophists, who almost followed a caricature of objectivity and fidelity to nature, should be saddled with a charge that they abandoned the real world for their Bibles.

Cuvier's methodology may have been naïve, but one can only admire his trust in nature and his zeal for building a world by direct and patient observation, rather than by fiat or unconstrained feats of imagination. His rejection of received doctrine as a source of necessary truth is, perhaps, most apparent in the very section of the *Discours préliminaire* that might seem, superficially, to tout the Bible as infallible—his defense of Noah's flood. He does argue for a worldwide flood some five thousand years ago, and he does cite the Bible as support. But his thirty-page discussion is a literary and ethnographic compendium of all traditions, from Chaldean to Chinese. And we soon realize that Cuvier has subtly reversed the usual apologetic tradition. He does not invoke geology and non-Christian thought as window dressing for "how do I know, the Bible tells me so." Rather, he uses the Bible as a single source among many of equal merit as he searches for clues to unravel the earth's history. Noah's tale is but one local and highly imperfect rendering of the last major paroxysm.

As a rough rule of thumb, I always look to closing paragraphs as indications of a book's essential character. General treatises in the pontifical mode proclaim a union of all knowledge, or tell us, in no uncertain terms, what *it* all means for man's physical future and moral development. Cuvier's conclusion is revealing in its starkly contrasting style. No drum rolls, no statements about the implications of catastrophism for human history. Cuvier simply presents a ten-page list of outstanding problems in stratigraphic geology. "It appears to me," he writes, "that a consecutive history of such singular deposits would be infinitely more valuable than so many contradictory conjectures respecting the first origin of the world and other planets." He ranges across Europe, up and down the geological column, offering suggestions for empirical work: study recent alluvial deposits of the Po and the Arno, dig in the gypsum quarries of Aix and Paris, collect "gryphites, the cornua ammonis and the entrochi" that may abound in the Black Forest. "We are as yet uninformed of the real position of the stinkstone slate of Oeningen, which is also said to be full of the remains of fresh-water fish."

A man who could end one of the greatest *theoretical* treatises in natural history with a plea for unraveling the stratigraphic position and faunal content of the Oeningen stinkstones knew, in the most profound way, what science is about. We may wallow forever in the thinkable; science traffics in the doable.

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

What your home could have in common with the Met, the Tate, and the Louvre.

Kathy Jakobsen's *Shaker Meeting House*, original lithograph. Signed limited edition of 225.

Beautiful, original works by artists who are represented in the world's great museums and galleries can be yours for very reasonable prices.

We offer original etchings, lithographs and serigraphs signed by Calder, Chagall, Dali, Miró, Renoir, Vasarely and other important artists.

Kathy Jakobsen's lively lithograph, *Shaker Meeting House*, is one of the many fine prints we've made available.

Our expert advice and full money-back guarantee are your assurances that the art you buy will have lasting value and beauty.

Send for our colorful, descriptive catalogue, without obligation.

Visit our new gallery located at 215 Lexington Avenue,
Mon–Fri, 9–5 PM. Telephone: 212-685-9400 Ext: 35

© 1982 OPCG, LTD

Original print collectors group, Ltd.

215 LEXINGTON AVE.,
DEPT. NH-40, NEW YORK 10016

PLEASE SEND ME YOUR FREE COLOR CATALOGUE WITHOUT OBLIGATION.

NAME ____________________
PLEASE PRINT

ADDRESS ____________________

CITY ____________________

STATE __________ ZIP __________

Free Enterprise in the Woods

Current administration proposals to give private concessionaires a larger role in the nation's parks would benefit by a look at the ups and downs of park service history

by Joseph L. Sax

McCauley's chicken toss is not the first thing that comes to mind when one thinks of the national parks, but it was once a leading tourist attraction at Yosemite. In the 1870s James McCauley built the first accommodation for hikers at the top of Glacier Point, 3,200 feet above Yosemite Valley. Visitors often amused themselves in those days by dropping objects over the cliff and watching them float down. McCauley, believing there couldn't be too much of a good thing, would appear on the scene carrying an old hen under his arm. Then, as one visitor recalled, "in spite of the terrified ejaculations and entreaties of the ladies, he deliberately threw it over the cliff's edge.... With an ear-piercing cackle that grew fainter as it fell, the poor creature shot downward ... until it became a mere fluff of feathers no larger than a quail ... and then—it was gone." The witnesses to this extraordinary feat immediately pitched into the landlord for his cruelty. "Don't be alarmed about that chicken, ladies," McCauley responded, "she's used to it. She goes over the cliff every day during the season." And sure enough, as they walked down to the valley floor, tourists met the old hen about halfway up the trail, calmly picking her way home.

The chicken toss was long gone by the time the National Park Service was established in 1916, but another of McCauley's inventions, the fire fall, was revived and elaborated by the Curry Company, Yosemite's major concessionaire, which continued it until 1968. As guests gathered in the valley during the evening, a porter would be sent up to

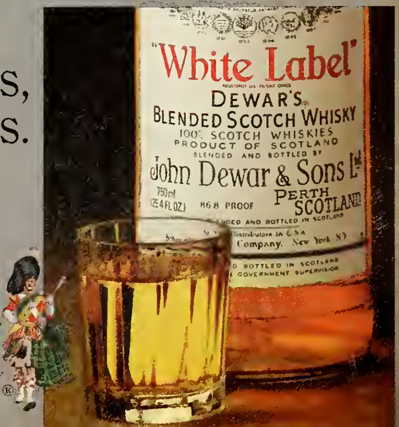
BRIGHT ANGEL TOLL ROAD
RATES OF TOLL
RIDING ANIMALS
PACK
SHOOTING THE RAPIDS OF COLORADO RIVER CANYONS
IN MOTION PICTURES
HEAD OF BRIGHT ANGEL TRAIL
KOLB BROS

The Bright Angel Toll Road was the main trail down into the Grand Canyon. For a time it was monopolized by Ralph H. Cameron, an opportunist who schemed to acquire other sites in the canyon by posting specious mining claims.

Northern Arizona University Libraries, Special Collections Division, Flagstaff

HE WAS never elected. But every night "Mayor" Orlo McBain is the last man to walk the streets of Culross, Scotland. He checks a knob, closes a gate and goes his way. The good things in life stay that way.

Preferred for smoothness, Dewar's® never varies.


"White Label"
DEWAR'S
BLENDED SCOTCH WHISKY
100% SCOTCH WHISKIES
PRODUCT OF SCOTLAND
BLENDED AND BOTTLED BY
John Dewar & Sons Ltd
PERTH SCOTLAND
750 ml
(25.4 FL OZ)
86.8 PROOF

Authentic.
The Dewar Highlander

BLENDED SCOTCH WHISKY · 86.8 PROOF · © 1981 SCHENLEY IMPORTS CO., N.Y., N.Y.

Elliott W. Hunter; Haynes Foundation Collection, Montana Historical Society, Helena

Tourists enjoy the Lower Falls in Yellowstone, about 1890.

Glacier Point to gather and light a pile of firewood. On the command, loudly given, to "let the fire fall," the lighted wood was pushed over the cliff and the embers slowly drifted down to an accompaniment provided by a violinist hired for the occasion.

Almost every major park has at one time or another barely been spared what a Senate committee once called "the vandalism of improvement." In 1872 a plan was put forward to build a dam above Yosemite Falls, which by thus replumbing nature would assure tourists a steady flow of water in all seasons. For some years entrepreneurs sought to build a steam-powered elevator to take visitors down into the Grand Canyon of the Yellowstone, and every generation revives a proposal to build a tramway from Yosemite Valley to Glacier Point, a scheme most recently rejected in 1974. Sixty years ago, a San Francisco engineer named Davol put forward a proposal to string a cableway across the Grand Canyon, from the El Tovar Hotel on the South Rim to the North Rim. A dozen one-inch metal cables would have graced the canyon's width, with cable cars hung underneath so that guests could have a clear view of its wonders. The National Park Service came within a hairbreadth of approving the plan, promoted on the grounds that it was the only logical means of crossing the canyon, would abate pressures to build a road, and would provide an alternative to the "awesome" thirty-mile mule ride from rim to rim.

The consequence of unbridled free enterprise in the parks was dramatically illustrated in Yellowstone a century ago. Established as a national park in 1872, Yellowstone was quickly invaded by as nefarious a bunch of promoters as the West had yet seen. One of the early superintendents, Robert E. Carpenter, set the tone for the 1880s when he observed that the park was created to be an instrument of profit to those who were shrewd enough to grasp the opportunity. The earliest grasper was the Yellowstone Park Improvement Company, which sought an exclusive lease of a square mile around each of the seven most desirable sites in the park, the sole right to serve visitors, and a monopoly of timber, grazing, and stock range within the park. A public outcry scotched this scheme, but the company did get a more limited lease and immediately set to the construction of a grotesque red-and-green hotel at Mammoth Hot Springs. The lobby featured a long line of vermilion spittoons and a stuffed mountain lion with a plaque in its mouth reading, Meet Me by Moonlight, Alone.

Bad taste was only one of the problems presented by this company, which later developed facilities at a number of other sites in the park. It hired hunters to poach park animals as a cheap way to feed its guests, and it routinely cut timber illegally for its construction needs. Despite these economies, prices were high, guests were forced to share beds, and food and service were the subject of continual complaint. One English traveler, who visited in 1884, remarked "when we say a bed is necessary, perhaps we overstate the case, it would be more proper to say a moiety of a bed, for traveling in the National Park, like the poverty to which it leads, makes a man acquainted with strange bed-fellows." The evils of monopoly were complemented by those of excessive competition on the part of companies that offered transportation within the park. Competing barkers met incoming visitors at the train station with high-pressure sales talks that routinely offered more than could be and was provided. High rates, bad service, and lack of coordination among companies, and between transportation companies and hotels, were standard.

The history of early Yellowstone was dreary and insignificant when compared with the intrigues of the park service's all-time archenemy, Ralph H. Cameron. An Arizona pioneer and politician, and one of the first tourist guides in the Grand Canyon, Cameron somehow acquired toll rights to the Bright Angel Trail—the principal path down into the canyon—in 1901, some years before the

Yosemite National Park Research Library, U.S. Department of the Interior National Park Service

SENTINEL HOTEL

Wagons leave the Sentinel Hotel in Yosemite at the turn of the century.

park was established. The dollar he charged each visitor and the poor service he provided were the mildest of his transgressions. Smelling bigger money, Cameron plastered the canyon with specious mining claims, ultimately totaling 13,000 acres of the most significant sites, from which he hoped to make his fortune as the man who owned Grand Canyon. Even after the government took over the toll trail, Cameron maintained his claim at Indian Gardens, an oasis halfway down the Bright Angel and the main stopping point for tourists on their way into the canyon. To coerce the government to yield to his demands, he refused to allow the installation of a privy at Indian Gardens and hired a caretaker to pollute the water supply so visitors could not get a drink.

Cameron's mining claims were palpably false, but for nearly two decades he fought the government's efforts to invalidate them. He took his case all the way to the Supreme Court, which finally ruled against him. But just as he was about to be evicted from his claims, he was elected U.S. senator from Arizona. There has probably never been a more scandalous case of a member of Congress using his office to protect private interests. Cameron instigated groundless investigations of park service management, used his office to impede park appropriation bills, and through his influence with Arizona officials kept his claims from being taken back. Ultimately, these excesses brought him down. In 1924, Louis Cramton, a leading congressman and a strong friend of the parks, came to see then U.S. Attorney General Harlan Fiske Stone (later chief justice of the United States) about the Cameron problem. "Mr. Attorney General," he said at the end of the meeting, "you don't know me, and you may think it strange that I should talk this way about a senator of the United States." "Mr. Cramton," Stone replied, "I haven't been here very long, but I know that there are fellows up there who would steal the Capitol if nobody was looking." Shortly thereafter, Stone appointed a special assistant attorney general to clean up the mess; and by 1925 the Grand Canyon empire of Ralph Henry Cameron was no more.

The Grand Canyon and Yellowstone experiences persuaded Congress to establish a system of regulated monopolies in the parks. Accommodations and services were turned over to a single concessionaire under contracts that gave the park service authority to limit facilities and to regulate prices and quality. Strict

PRINCESS CRUISES
The Magnificent Adventure

Circle the Pacific in '83.
Depart Los Angeles March 26. Sail to enchanting South Seas isles. Tahiti. New Zealand, Australia, Bali, Singapore, Manila, Hong Kong. On to intriguing China, Japan, Honolulu. 70 days round trip, or choose a segment. Registry: British. See a travel agent or send for our '83 Cruiseguide. Princess Cruises, Dept. NHP62, 2029 Century Park East, Los Angeles, CA 90067.

South Pacific/Orient · Alaska · Transcanal · Mexico · Caribbean

ASIAN TREASURES

Asia: Traditions and Treasures by Walter A. Fairservis Jr, with color photographs by Lee Boltin. 86 color plates of peerless Asian treasures; 114 sepia plates of early, rare, and unique photographs from the collections of the American Museum of Natural History.

The American Museum of Natural History created a special, limited edition of 500 autographed copies of **Asia: Traditions and Treasures** to commemorate the opening of the magnificent Hall of Asian Peoples, the largest collection of Asian ethnology and art in the West. Some of these rare volumes were presented to generous contributors to the hall, and the rest were offered for sale to a select group of Museum donors and friends. This is the first public offering of this limited edition.

Only forty-five numbered volumes of this collector's edition remain. Each volume of this strictly limited edition is bound in a covering of pure silk, slipcased, and stamped in 22 karat gold. Each book is individually signed by Dr. Fairservis (who spent 14 years creating the Hall of Asian Peoples) and Mr. Boltin (the well-known photographer who also took all the King Tut photographs). Volumes are $135 each, plus $5 shipping and handling.

To order, please call Robert De Angelis at the American Museum of Natural History, (212) 873-1498.

This offer is open *only* to Members of the American Museum of Natural History.

regulation solved one problem only to create another almost as troublesome. The short seasons and remote locations of most parks made it nearly impossible for a private business to earn a profit from the basic facilities the park service was willing to permit, and under the price and quality controls it demanded. Glacier National Park Company lost money consistently for decades. The concessions at Mount Ranier, established at park service urging by Seattle businessmen, never reported a profit between 1916 and 1945. For the less frequented parks, concessionaires have often been difficult to find.

Even at a park as popular as Yellowstone, the hotels regularly operated at a loss that was made up only by excellent returns from transportation services. One consistently successful operation was Yosemite, but this was largely due to the government's tolerance of a long-established concessionaire who offered almost the entire range of services available in a small city. A 1962 study reported that, in addition to taking advantage of a swimming pool and golf course, "one can get his watch repaired, his dog kenneled or his horse shod in Yosemite Park by doing business with the concessioner . . . attractions which the Service would not permit elsewhere and will not allow to be expanded in Yosemite."

Of course, the government could have taken over the concessions, and it has occasionally done so in special cases. But Congress has never been very keen on the idea of operating gas stations and souvenir shops; and in those places where successful private concessions were operating, the owners united to fight the specter of creeping socialism. However exaggerated their fears might have been, it can hardly be denied that the prospect of government issue hotels and restaurants lacks a certain charm.

"GNR" stood for Great Northern Railway.

Burlington Northern Railroad

Blackfoot Indians entertain guests at Glacier Park Lodge.

Burlington Northern Railroad

Not everything in early park history was bleak, however. When the National Park Service was established as an independent bureau in 1916, its first director—Stephen Mather—inherited all the chaotic problems of the parks' first half-century. Mather was a distinctive sort of government official whose like will doubtless never reappear. A millionaire businessman who had made his fortune promoting Twenty-Mule Team borax, Mather took over the parks almost as a hobby. When Congress refused to appropriate needed money, Mather reached into his own pocket for the funds. And he hired a cadre of top assistants whose meager salaries he supplemented from his own fortune.

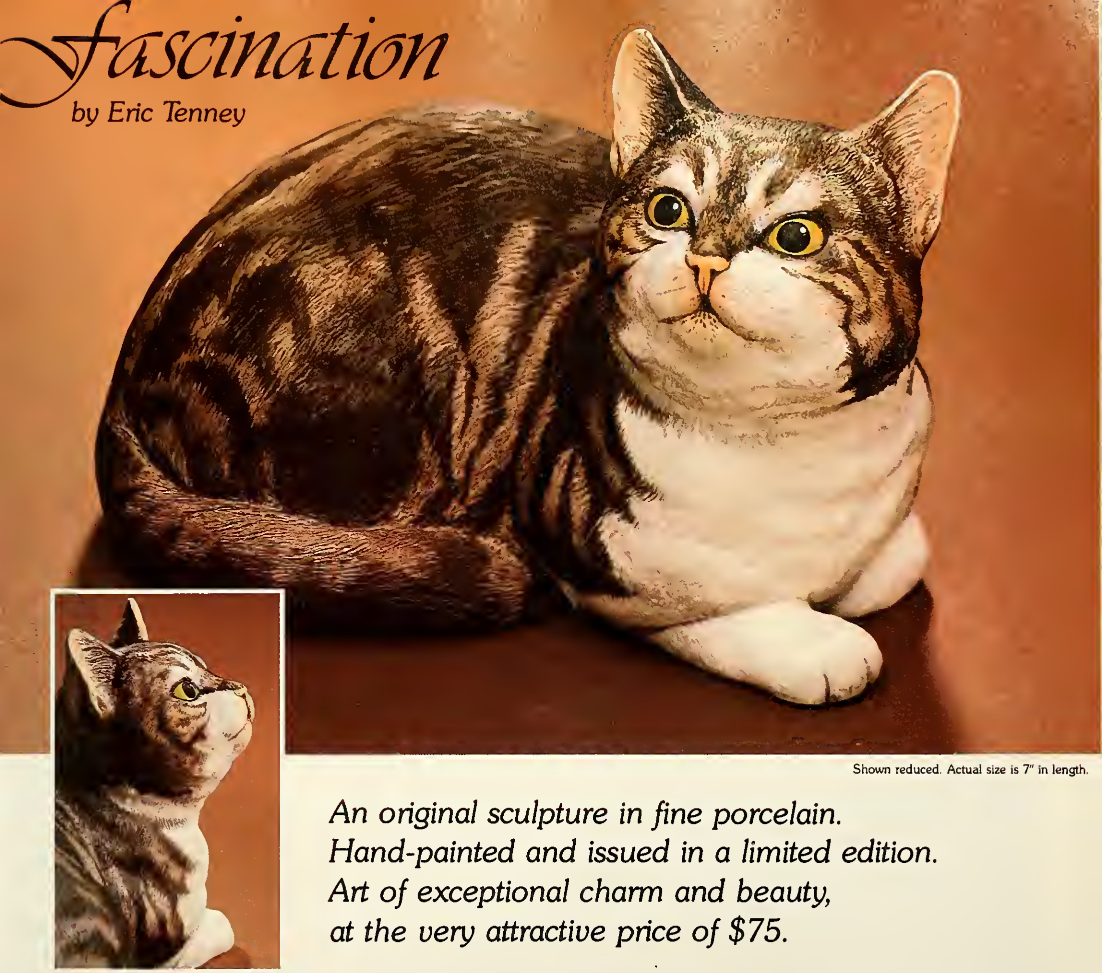
Not content merely to keep fighting rearguard actions against aggressive entrepreneurs, Mather evolved a brilliant solution that served the parks well for many years. His extraordinary powers of persuasion and his unbounded self-confidence helped him convince big business—especially the railroads—to build elegant, high-quality hotels in the parks and to operate them as showcase examples of fine service at reasonable prices. He even got the railroads to finance promotional materials of exceptional quality, at a time when the parks needed to build a constituency of influential citizens. Of course, the idea was not original to Mather, for the railroads were already in the resort business; but half a century ago, places like Glacier National Park and the North Rim of the Grand Canyon were far from the major paths of tourist travel.

The railroads were a happy choice as concessionaires, for they had the capital to build to the lofty specifications that Mather had in mind, and they could look to passenger fares for their profits, rather than to exploitation of the park's natural resources. Hotels and restaurants could be run at a loss, and often were, and still the concession might prosper. By this means, Mather set an unparalleled standard of "class" in the national parks.

The greatness of Mather was his un-

fascination

by Eric Tenney



Shown reduced. Actual size is 7" in length.

An original sculpture in fine porcelain.
Hand-painted and issued in a limited edition.
Art of exceptional charm and beauty,
at the very attractive price of $75.

ERIC TENNEY is one of today's most beloved and accomplished animal artists. An award-winner at the prestigious Edinburgh Festival. Featured in important exhibitions at London's Tryon and Sladmore galleries. And internationally acclaimed for his portraits of the endearing animal characters of the best-selling book, "Watership Down." His works are sought after on both sides of the Atlantic.

Now, for the first time ever, the artist has turned his talents to a medium that collectors especially prize: fine porcelain sculpture. The result is a work of pure magic, called *"Fascination."* Crafted in fine, hand-painted porcelain, this delightful work of art will be issued at the very attractive price of $75—which may be paid in three convenient monthly installments of $25 each.

In "Fascination," Eric Tenney portrays an inquisitive Tabby cat, with a loveable personality that will instantly charm any viewer. Beguiling in spirit, the sculpture is also remarkably lifelike in detail. Every feature is captured with delicate care. The glowing eyes. The little pink nose. The very nap and texture of the fur!

"Fascination" will be individually crafted, completely hand-painted—and will bear the artist's signature on its base. Examples of the sculpture will be crafted under the supervision of Franklin Porcelain in Japan, home of some of the world's most gifted porcelain craftsmen. And in the tradition of classic porcelains, it will be issued in a limited edition. At the end of this single year, 1982, the edition will be permanently closed.

Owning and displaying this enchanting hand-painted sculpture is certain to bring you pleasure for years to come.

But to reserve "Fascination" by Eric Tenney, you should act promptly. To be valid, the accompanying Reservation Application must be returned to Franklin Porcelain, Franklin Center, Pennsylvania 19091 no later than July 31, 1982.

© 1982 FP

RESERVATION APPLICATION

FASCINATION

by Eric Tenney

Valid only if postmarked by July 31, 1982
Limit: One per person

Franklin Porcelain
Franklin Center, Pennsylvania 19091

Please accept my reservation for "Fascination" by Eric Tenney. This limited edition sculpture will be individually crafted for me in fine, hand-painted porcelain.

I understand that I need send no money at this time. I will be billed in 3 equal monthly installments of $25.* each, beginning when the sculpture is ready to be sent to me.

**Plus my state sales tax and a single charge of $3. for shipping and handling.*

Signature____________________
ALL ORDERS ARE SUBJECT TO ACCEPTANCE.

Mr.
Mrs.
Miss____________________
PLEASE PRINT CLEARLY

Address____________________

City____________________

State, Zip____________________

flagging commitment to protection of the parks' basic resources, and his determination to control the concessions so that their activities never departed from his vision of what was needed for building a constituency. He made it clear that he was in charge, and he turned the concessionaires to his ends, never permitting the profit motive to determine development.

He also exercised a kind of personal despotism that would be unimaginable today. When the Great Northern Railway was building its hotel at Many Glacier, for example, it put up a sawmill to aid in the construction. Mather was displeased with this commercial intrusion, but he permitted the mill to operate temporarily, ordering it to be dismantled by a certain date. When the railroad delayed, Mather appeared on the scene—it happened to be the day of his daughter's birthday—and ordered his staff to invite the hotel guests to step outside for a demonstration. Then, as if he were laying a cornerstone, he lighted a fuse and blew up the sawmill with thirteen charges of TNT. With each detonation, he became more cheerful. "Just celebrating my daughter's nineteenth birthday," he said. The sawmill was out of business. The Great North-

FOR NORTHERN PACIFIC RY. CO

Guests did not have to rough it at the Grand Canyon Hotel.

Burlington Northarn Railroad

A thirty-passenger bus negotiates Logan Pass in Glacier National Park.

Glacier Park Inc.

ern was outraged, but it quietly removed the debris and absorbed the lesson.

The worst one could say of Mather was that he occasionally let his conception of interior elegance run rampant. At the Great Northern's beautiful hotel in Glacier National Park, for instance, guests arrived in rickshaws and entered through a Chinese pagoda decorated with imitation cherry blossoms. In the dining rooms, whose floors were covered by bearskins and Navaho rugs, patrons chose between Swiss-costumed or geisha waitresses and ate to the sound of tom-toms beaten by Blackfoot Indians (educated at Carlisle University). A similar style was adopted at Fred Harvey's El Tovar on the South Rim of Grand Canyon, and the Union Pacific hotels in Bryce Canyon, Zion, and Grand Canyon's North Rim. The tradition of elegance in the woods reached its apex when the Curry Company built the Ahwahnee Hotel at Yosemite in 1927, a facility devoted to the principle of "every comfort consistent with 'roughing it deluxe.'" The high point of the year at the Ahwahnee was the Bracebridge Christmas Dinner, which was based on Washington Irving's description of an 1812 English festival and held in the hotel's baronial dining room. At this annual event, the manager and his wife dressed as a squire and his lady, a chorus sang for entertainment, and the meal consisted of five succulent courses ranging from peacock pie to plum pudding.

Beyond his success in turning the railroads to his purpose, Mather was also fortunate in that many of the less famous and less visited parks had as concessionaires in those days local people who had grown up in the parks, knew them intimately, and were as devoted to their protection as was the park service. Some concessions arose from the smallest beginnings. At Mesa Verde in Colorado, for example, the chief ranger's wife began serving meals to accommodate the few tourists who passed by, initiating a family-operated concession that remained for many years. Crater Lake National Park in Oregon was established through the efforts of a local man, William Gladstone Steel, who became its superintendent and later its devoted although never financially successful concessionaire. The Curry family operation in Yosemite grew into one of the largest and most successful enterprises in the national parks, and the famous photographer Ansel Adams has had a studio as a concession in Yosemite Valley for many years.

All this has now virtually disap-

The pleasures of the palate prevail in West Africa. Try an appetizer of country pate, smoked salmon, or a mound of chunked lobster in a delicious cream sauce. For an entree, you might enjoy a rack of baby lamb or "Veal Africain," which is a veal cutlet wrapped around a banana and topped with a delicate curry sauce. As for dessert, perhaps a flaming rum omelette filled with fruit, or a baked Alaska.

Baked Alaska in Africa?

In West Africa the peanut is a gastronomic adventure. Start with a flavorful chicken-groundnut stew, then move on to a score of delicious dishes that feature these luscious legumes.

The roots of soul food go back to West Africa. You'll find greens, yams and barbecue galore. Taste them, you'll know why they're a popular part of our culinary tradition.

AIR AFRIQUE

Discover West Africa. Call your Travel Agent or your nearest Air Afrique/Air France office today.

Africa begins with Air Afrique. And it's just seven hours to the New Sun... West Africa.

© 1982 VOLKSWAGEN OF AMERICA

Save big on first class transportation.

How big?

If you order a Quantum at your local VW dealer and take delivery in Europe, you can save up to $1000*.

Then once you're there you save even more since you don't have to rent a car.

You can also save on Volkswagen Sciroccos, Jettas, Rabbit Convertibles, Vanagons, and Campers.

And when you come home, we'll ship it across the ocean free.

How is all this possible?

Ask your Volkswagen dealer.

Nothing else is a Volkswagen.

*Based on manufacturers' suggested retail price of vehicles P.O.E. United States as compared to delivery in Europe prices. Import duty, broker's fee and local delivery charges additional.

ex-cité

(Something that

In a world where many people's lives are all too routine, moments of true excitement are an essential part of a healthy lifestyle.

Providing those moments is Bally's business.

A leader in many facets of the amusements industry, Bally makes playful excitement available conveniently and inexpensively through family amusement centers and family amusement restaurants, theme parks, and electronic video games.

By entering into an exciting world of fantasy for a few minutes or a few hours, families can gain the immeasurable benefits of a brief 'vacation' from the routine that is an inevitable part of life in the modern world.

And young people enjoying the excitement of video games can gain a first glimpse into the world of micro-computers, a career field with boundless opportunities.

-ment
excites or arouses)

©BALLY. 1982

Bally's Six Flags Corporation provides entertainment for the entire family, and is also one of the nation's largest youth employers.

Today, more than ever, moments of escape into a world of fun and excitement are an essential part of the good life. And those moments are the heart of Bally's business.

Fun is our business.

Bally®

Ralph H. Anderson; Yosemite National Park Research Library, U.S. Department of the Interior National Park Service

The highlight of the year at Yosemite's Ahwahnee Hotel was the Bracebridge Christmas Dinner, based on Washington Irving's description of an 1812 English festival. The jester in 1934 was photographer Ansel Adams.

peared, however. The family businesses are gone. The railroads, which on balance are much more to be praised than censured, began their exit when the automobile era displaced them. In Yosemite the Curry Company sold out in 1973 to the Music Corporation of America (MCA), one of the nation's largest recreation conglomerates. At Yellowstone, the concessionaire is now TWA Service, Inc., which also owns the concessions at Zion, Bryce Canyon, and the North Rim of the Grand Canyon. Restaurant Associates is in charge of the Everglades National Park; Greyhound Food Management has acquired the concession at Glacier; and one of the oldest family-owned concessions, at Mesa Verde National Park, is now managed by ARA Services, a commercial and corporate food-service company.

The acquisition of park concessions by large recreation-industry corporations presents a novel problem. More than a century's experience demonstrates that without supplementary, high-profit amusement facilities, traditional hotels and restaurants are not very remunerative. There is little evidence to suggest that the new breed of industrial concessionaires wants anything less than maximum profits, as was demonstrated a few years ago when MCA started using Yosemite Valley to film a TV series featuring "a gorgeous nude sunbather doing her thing atop a Winnebago" and sought to develop a convention business in the park with brochures reading, "This isn't no man's land. Or Primitive Wilderness. This is civilization."

The prospects seem grim. Uncontrolled free enterprise will only lead us to a current version of McCauley's chicken toss, but regulated industries find it increasingly difficult to function both properly and profitably. The government will not, and probably should not, go into the concessions business.

Little attention has been given to the possibility of reviving in modern guise Mather's scheme of recruiting major enterprises to provide minimum profit, or even nonprofit, showcases. Large corporations have shown themselves willing to sponsor high-quality radio and public television programs. They are important patrons of the arts and they have supported first-class architecture. May we not hope that major companies can be persuaded to underwrite facilities—without direct advantage to their balance sheets—that would offer visitors services of a quality and dignity suitable to the crown jewels of America's landscape?

If such an approach were pursued, the three major problems of park concessions—profitability, quality, and the appropriateness of activities and services offered to visitors—could each be handled separately and without conflict in a manner consistent with Congress's goals for the national parks. The park service could seek out concessionaires with the skills and commitment, as well as knowledge of the area, to offer the finest services available. It could define the sort of activities and facilities "necessary and appropriate" (to use the language of the governing law) to management of the parks in accord with the intent of the Congress in establishing these places. Neither the park service nor the concessionaires would be obliged, as is now the case, to depart from those goals in order to assure the profits that an ordinary business enterprise requires to sustain itself; the economic gap would be filled by subventions from corporate or philanthropic

The World 'n General

GENERAL TOURS
TAKES YOU TO
EGYPT
ECONOMICALLY!
9–17 Days from $1437*
includes Air Fare
THE ONLY WAY TO GO...
THE RIGHT PRICES...
THE RIGHT WAY...
THE
GENERAL TOURS
WAY!
Tour Features Include:
- First Class 4 or 7 Day Nile Cruises
- Deluxe Hotels throughout
- American Tour Manager

*All prices per person double occupancy from N.Y. Single supplements available

ASTA American Society of Travel Agents USTOA
Member of the First Family of Travel

What A Way To Go!

GENERAL TOURS, INC.
711 THIRD AVE.
NY,NY 10017
212-687-7400 NH 6/82

YES! I want to see Egypt.
Please send: my free copy of
THE EGYPT BOOK

name ______
address ______
______ zip ______
my travel agent: ______

sponsors who would benefit from their association with one of the supreme achievements of American public policy, places visited by tens of millions of domestic and international tourists.

Unless the three issues noted above *are* separated, the national goals for the parks will never be adequately met. Private enterprise, left to meet its ordinary market needs, will overdevelop the parks, as the MCA experience at Yosemite, among many others, demonstrates. The park service does modify its own best judgment about the nature and intensity of appropriate use of the parks in order to meet the economic demands of concessionaires. This was recently revealed at Grand Canyon National Park. In 1979 the park service had put forward a plan to reduce peak season rafting down the Colorado River in Grand Canyon, but the private firms that ran those trips organized to oppose the plan, which threatened their income, and the park service was obliged to back down. This, too, is not an uncommon event.

To argue that concessionaires are simply giving the public what it wants in the parks does not address the problem at all. There is a considerable, albeit insufficiently recognized, distinction between what the American public wants its national parks to be, and what individual visitors will spend their money on if the opportunity presents itself. From the days of James McCauley onward, businesses have profitably marketed within the parks all the same goods and services they sell elsewhere—from carnival shows to tawdry souvenirs and cable cars. Indeed, there is every reason to believe that one could successfully sell condominium apartments in the midst of Yosemite Valley or Yellowstone National Park. But the American public and Congress have long held that the national parks should be something other than profit-maximizing public-land investments. Since, for the reasons noted earlier, they can rarely fulfill that other role either under unbridled free enterprise or under the sort of regulated monopoly practices that are now being used, the time seems ripe to look for a new technique. The showcase concession, in a different form and at a different time, has proved its worth. It's time to bring that excellent idea up to date.

Joseph L. Sax is a professor of law at the University of Michigan and the author of Mountains Without Handrails: Reflections on the National Parks, *published by University of Michigan Press.*

The World 'n General

GENERAL TOURS
takes you to
RUSSIA
For Under
$100/DAY!*
including air fare
11 QUALITY TOURS
10-21 days
NOW YOU CAN SEE FOR YOURSELF!

- Finnair wide-body jets
- first class & deluxe hotels
- three meals a day
- full sightseeing
- all transportation in USSR
- theater performances
- American tour manager
- HAPPY TRAVEL gift
- many extras
- PLUS early booking PRICE GUARANTEE

*per person double occupancy from NY

ASTA American Society of Travel Agents USTOA
Member of the First Family of Travel

What A Way To Go!

GENERAL TOURS, INC.
711 THIRD AVE.
NY,NY 10017
212-687-7400 NH6/82

YES! I WANT TO SEE FOR MYSELF!
Please send my free copy of
THE COMPLETE
RUSSIA BOOK

name ______
address ______
______ zip ______
my travel agent: ______

Sealed in Amber

Rare pieces of amber provide a glimpse into symbiotic associations dating back twenty-five to forty million years

by George O. Poinar, Jr.

photographs by Raymond A. Mendez

Fossils are the preserved remains or other evidence of organisms that lived in the past. The fossil record tells us what plants and animals existed at, roughly, a certain time in the earth's history, but what it usually cannot tell us are the relationships that existed between these long-dead organisms. Among the most intimate of all relationships are those involving symbiosis, the living together of individuals of two different species. Symbiosis takes many forms: a species may live in another's environmental niche (inquilinism), be carried from habitat to habitat by another (phoresis), or actually take nourishment from its associate (parasitism).

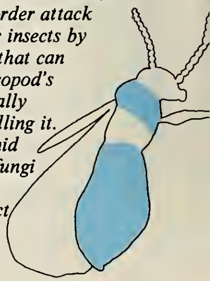
Were the dinosaurs plagued with ticks? Did insects transport mites and nematodes millions of years ago as they do today? Did parasitic relationships occur between nematodes, fungi, and insects? Combining the study of fossils and symbiosis may help answer such questions, but the information available to work with is limited. Animals found together in fossil form generally represent a thanatocoenose, an assemblage of individuals that died together, but such finds reveal little about their relationships during life. Also, in many symbiotic associations, one party is small and soft bodied and apt to be destroyed during the fossilization process. After death, parasitic worms and other invertebrates that have few or no hard parts are decayed rapidly by bacteria and fungi. Hard structures, such as bones, shells, and wood, decay less easily and are more likely to be preserved, but these remains normally show no evidence of symbiosis.

What is needed in the study of fossil symbiosis is a method of fossilization involving a quick death—to insure that the normal relationship between the two organisms is undisturbed—and preservation of the whole organism. One type of preservation that satisfies the requirement of preserving entire soft-bodied organisms in a gentle but rapid manner is amberization. In this process, tree resin functions as an embalming medium. After a period of time, the resin undergoes physical and chemical changes resulting in the formation of what is called amber. Amberization may not tell us whether dinosaurs had ticks or archaeopteryx had lice, but it can reveal a great deal about smaller organisms caught in resin flows.

Certain species of trees, such as the kauri gum (*Agathis australis*) of New Zealand, the gum arabic tree (*Acacia arabica*) of Africa, the sandarac (*Tetraclinis articulata*) of Australia, and the algarroba (*Hymenaea courbaril*) of South America, produce copious amounts of resinous sap. These flows can be quite rapid and extensive, engulfing organisms living on the bark of the tree. Slower flows act as traps for both crawling and flying creatures not strong enough to free themselves from the sticky surface. Their struggles only plunge them deeper into the deposit until they are completely covered. Sometimes, successive flows of sap occur fairly rapidly, and a partly exposed, trapped insect may start to decay and then be completely covered several days later by another flow. This explains why saprophytic fungi (which live on dead or decaying organic matter) are occasionally encountered on partly decayed insects in amber.

As time progresses, the volatile components of the sap disappear, and the entombed organisms are left in resin that must undergo still further changes to become amber. Not all resins change into amber, and the conditions that

Twenty-five million years old, these translucent pieces of amber come from deposits in the Dominican Republic. The photographs on these pages provide a closer look at some of the insects trapped inside.



In this unusual parasitic relationship, an entomogenous fungus of the order Entomophthorales (blue in accompanying sketch) covers a termite preserved in amber. The fungus was identified on the basis of spores produced on the surface of closely appressed fungal filaments. Although only rarely encountered today on termites, members of this order attack a number of other insects by producing spores that can penetrate an arthropod's body wall, eventually consuming and killing it. Under warm, humid conditions, these fungi can be important regulators of insect populations.

Nematodes frequently utilize insects to move from place to place, a symbiotic association known as phoresis. Commonly called roundworms, nematodes are fragile, cosmopolitan, wormlike animals that are found in soil or associated with plants and animals. Many of the free-living forms, which feed on bacteria in the soil, depend on insects for transportation. The dispersal stages are usually restricted to so-called survival, or dauer, juveniles, which are resistant to desiccation and heat and can go for long periods without feeding. This amber specimen contains some nematodes of the order Rhabditida (blue) that released themselves from the abdomen of an ant when it became immersed in sticky sap.

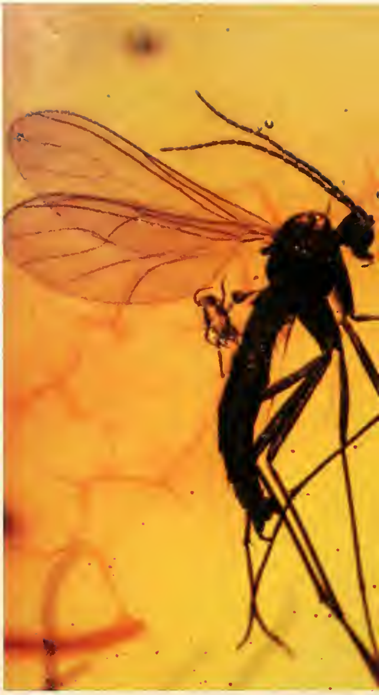
cause the transformation are not completely understood. The process normally takes millions of years and may involve such physical factors as heat, pressure, contact with sea water, and possibly the presence of certain minerals in the environment. During this process, which undoubtedly includes oxidation and polymerization, the melting point reaches 482° to 572°F.

Most of the soft tissues of insects caught in resin are broken down enzymatically or destroyed by microorganisms long before amberization takes place. Some insects found in amber show traces of tissue remains, but these are usually poorly preserved. Recently, however, an examination with the electron microscope of tissue in the abdomen of a female fungus gnat revealed the presence of nuclei, mitochondria, ribosomes, endoplasmic reticulum, and lipid droplets in muscle and epidermal cells. This remarkable degree of preservation demonstrated some unexpected fixative qualities of plant resin. It also raises the possibility of extracting DNA from the nuclei and culturing it for study.

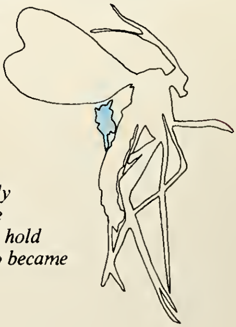
Amber is found in many parts of the world, including Canada, Alaska, Lebanon, Mexico, the Dominican Republic, and the region bordering the Baltic Sea. Until the past decade, the major source of amber seen in the United States has been the Baltic region, extending from Denmark across Germany, Poland, the Soviet Union, and the Baltic States. Amber from this area has been prized for centuries, at one time for supposed magical properties related to the electricity it acquires when rubbed (the Greek word for amber is *elektron*). Ancient views on the origin of amber ranged from the tears of birds to hardened pine resin. In this century, resin from an extinct tree, *Pinus succinifera*, was for a time considered to be the source, but more recent studies with infrared spectroscopy and pyrolysis mass spectroscopy suggest a species of *Agathis*, a genus found in many warm parts of the world. Forty million years ago—the estimated age of Baltic amber—the climate of the Baltic region was subtropical. Today, the climate is temperate, and the *Agathis* forests are long gone.

Not all amber has the same characteristics, and even specimens from the same geographical region may vary considerably. Much of the Baltic amber is characterized by masses of air bubbles that give it a cloudy appearance. The number of bubbles present probably indicates the type of resin flow. Thick resin flows may have retained more bubbles than thinner flows, in which most bubbles may have risen to the surface and disappeared into the atmosphere. The masses of air bubbles that often surround and impart a milky color to insect inclusions probably arose from gases escaping from microorganisms at work on the tissues of the trapped victims. Baltic amber can also be recognized by certain characteristic organic inclusions, such as oak hairs or certain types of insects. Commonly encountered in Baltic amber are March flies and fungus gnats, insects characteristic of warm, humid areas.

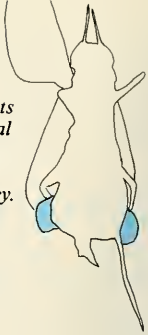
Another major source of amber is the Dominican Republic in the New World, where amber has only relatively recently been mined commercially. The age of Dominican amber has been estimated at 25 million years, although some types are much younger and others much older than this figure. On the basis of infrared spectroscopy, still existent leguminous trees of the genus *Hy-*

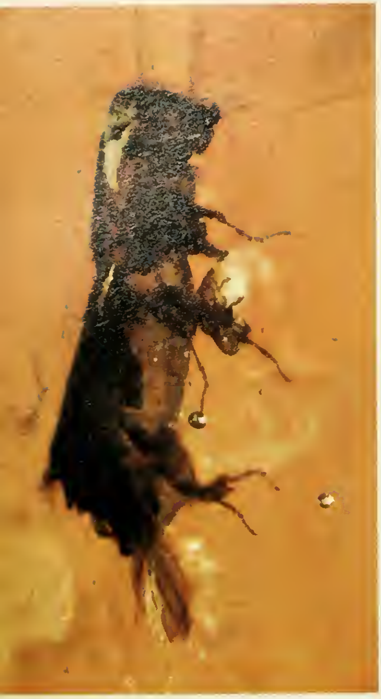


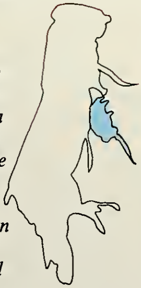
Like nematodes, mites often rely on insects for dispersal. This mite (blue) was hitching a ride on an adult midge when the latter was caught in a fresh resin flow. The tiny acarine barely had a chance to release its hold before it also became trapped.



Fossil insects are often found with bulges or protuberances that cannot be readily identified. This fly contains a pair of "saddlebags" (blue) attached to its abdomen. Whether they represent internal parasites, some noninfectious disease, or an artifact resulting from a rupture of the insect's integument remains a mystery.







Many mites find the tunnels of bark beetles a hospitable habitat for growth and reproduction. The easiest way for a mite to locate one of these tunnels is to cling to a beetle as it searches out new locations. The wood-boring beetle in this specimen landed by some miscalculation in a resin flow. Its hitchhiker, a so-called tortoise mite (blue), attempted to leave its ill-chosen carrier and was itself stuck in the sap.

menaea are generally considered to have produced at least some of this amber, but the possibility of other trees contributing other types of the amber in the Dominican Republic cannot be ruled out.

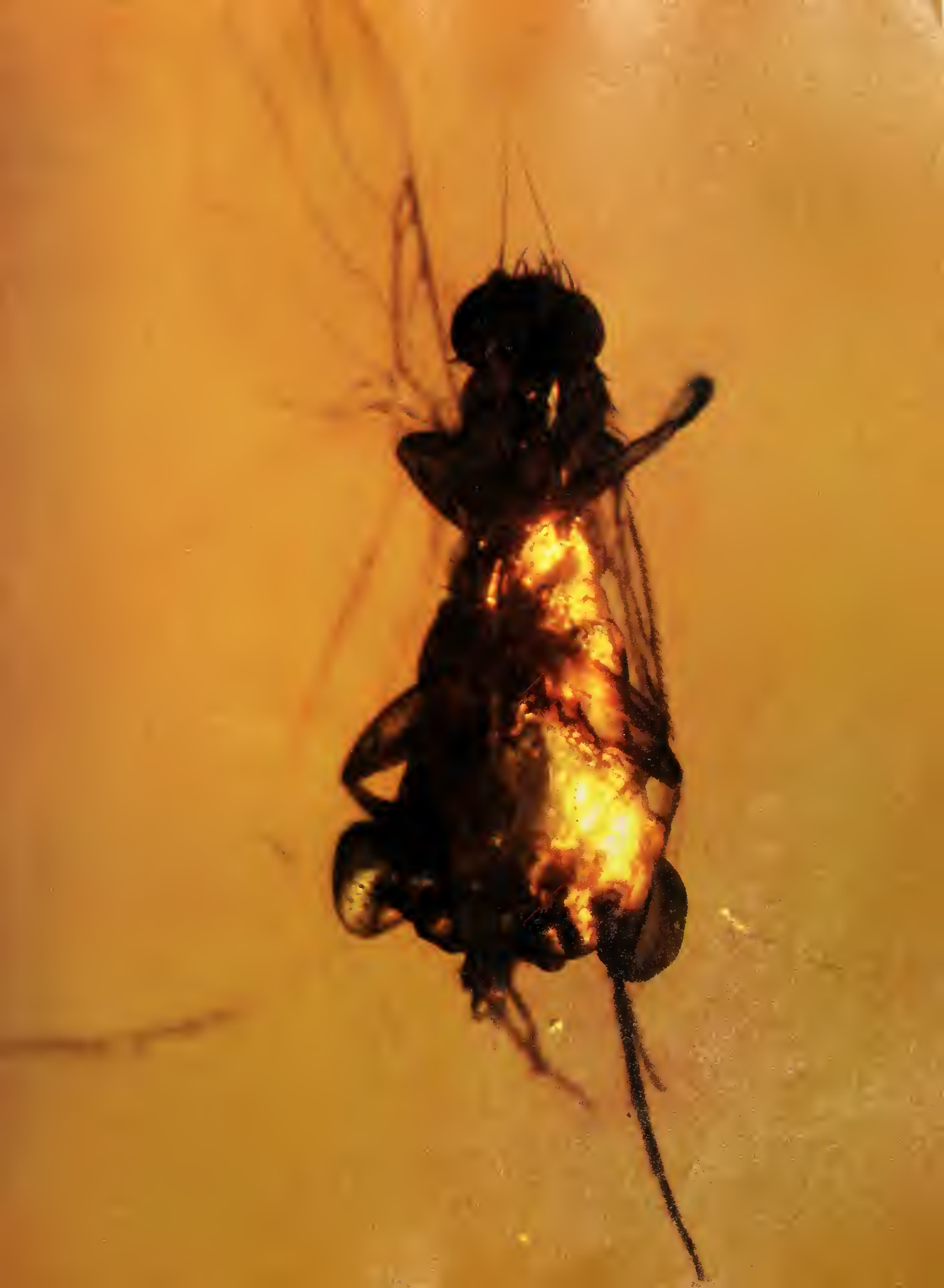
After visiting the mines and examining amber from the Dominican Republic, I found that each area produces a distinct type recognizable, when polished, by color, hardness, and odor. Nevertheless, some generalizations can be made. Dominican amber is usually clear, with little or no succinic acid. The arthropod inclusions are well preserved, with ants and bark beetles being some of the more commonly encountered insects. The predominance of certain insect groups may be related to the increased occurrence of sap flows during rainy seasons. There are also authentic records of mammalian hairs, lizards, and at least one frog preserved in Dominican amber.

Organic inclusions in amber are by no means common, and evidence of animal associations even less so. On the average, perhaps up to five insect inclusions are found in every one hundred pieces of amber examined, and out of one hundred such fossils, perhaps one will show a symbiotic relationship. Thus far, only two types of symbiotic associations—phoresis and parasitism—have been found in amber. Phoresis occurs quite commonly today among insects and other invertebrates. Many species of mites and nematodes utilize flies and beetles to get from an environment that has become unfavorable to one more promising for growth and reproduction. When the carrier arrives at its destination, the riders leave and resume normal development, usually by feeding on microorganisms in the environment.

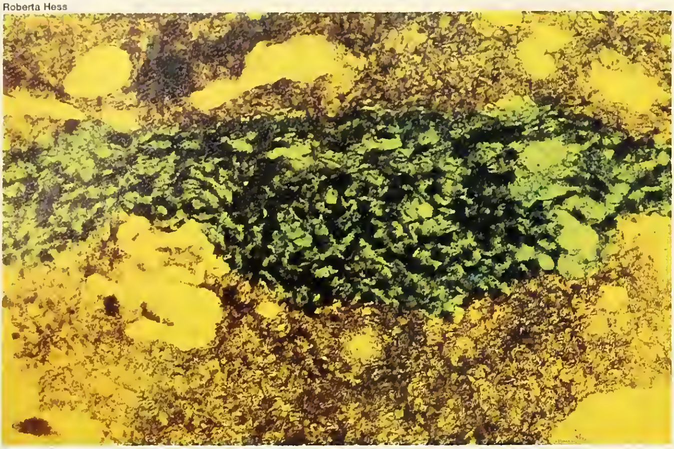
Parasitic associations involving insects are usually more difficult to identify than phoretic ones since most parasites are internal and cannot be seen through the thick exoskeleton of their hosts. The problem is even greater when the insect is encased in amber, but fossilized parasites occasionally disclose their presence. Forms of entomogenous fungi that sporulate on the surface of their hosts can be recognized. Internal parasitic nematodes that attempted to leave their insect host when the latter was caught in a fresh sap flow can now be readily observed in amber. Some internal wasp parasites reveal their identity through the formation of a larval sac, which emerges through the intersegmental membranes of their hosts.

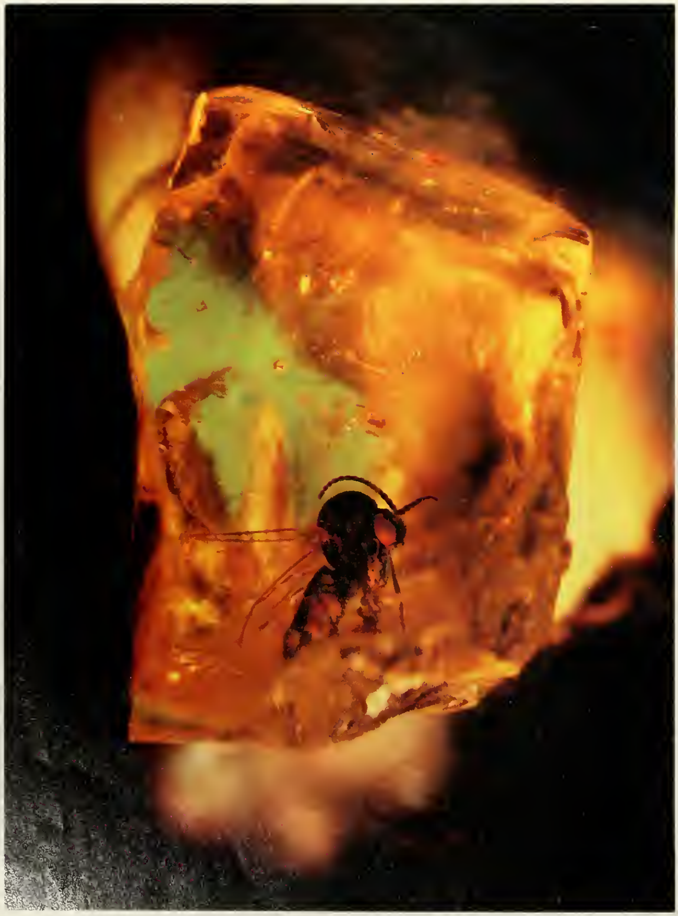
Examples of these types of symbiosis as revealed in amber tell us that phoretic and parasitic associations similar to those occurring today existed at least as long ago as twenty-five to forty million years. Whether the specific associations caught in amber still exist is not known. They have not been reported, but perhaps they have not yet been discovered. For example, dauer nematodes (nonfeeding juveniles) have been preserved in amber as they emerged from the abdomen of ants, something no modern nematode is known to do. Somewhere in the world, however, such an association may exist.

With our relatively sparse knowledge about present-day and fossil symbiotic associations, very little can be said regarding the evolutionary stability of the specific examples shown in the accompanying photographs. The challenge is twofold—to increase our knowledge about past and present symbiosis and to exercise our control over the environment to preserve the living forms for another twenty-five to forty million years. ☐



Roberta Hess





George O. Poinar, Jr.

Fly Mummy

In most insects that have been preserved in amber, microbial activity or natural decay processes have long since destroyed internal cells, leaving only hard external tissue, the exoskeleton. In a recently discovered piece of Baltic amber, however, some of the amberizing tree resin entered the body cavity of an entrapped fungus gnat, resulting in a remarkable degree of preservation of such soft tissues as epidermis and muscle. In fact, this forty-million-year-old fly, bottom, contains the best-preserved specimens of fossilized soft tissue ever found.

The gnat was entombed in a natural position, with its legs partly pulled up against the body and its two wings partly outstretched, almost in position for flight. The fly's large, bubblelike eye dwarfs its head, and one antenna is broken off in the middle. One section of the elongate, segmented abdomen, where internal tissues have not been preserved, is virtually transparent. Particles of organic matter, including a stellate plant hair that may be from the bud scale of an oak tree, also lie embedded in the amber.

The creation of this rare fly fossil is attributed to mummification, brought about by the rapid drying of tissues, and the special qualities of the mummifying resin: the presence of natural fixatives and of antibiotic properties that served to destroy or retard the action of microorganisms. The preservation of intracellular structures can be seen in electron micrographs that have been made of the fossilized fly's abdominal sections. For example, an electron micrograph of an epidermal cell, top, reveals a nucleus (green) containing dark clumps that resemble the genetic material chromatin. Efforts are now being made to determine whether some units of the fly's DNA might still be capable of replication. The discovery of viable DNA would indicate, not necessarily that the ancient fly could be resurrected, but perhaps more important, that other, more protected forms of life, such as bacterial spores, may be able to survive such catastrophic events as glaciation or even interplanetary travel—a process that some scientists have recently invoked to explain the origins of life on Earth.

NATURAL HISTORY MAGAZINE

SAVINGS CERTIFICATE

For *FOR THE SUM OF 9 DOLLARS*

This savings certificate saves you $9.00 off the single copy rate for 1 year on new subscriptions or renewals (12 beautiful and thought-provoking issues) of NATURAL HISTORY magazine, including membership in the American Museum of Natural History and all the benefits that go with it. As soon as we receive your order, we'll start your subscription and send your membership card.

☐ **YES,** Please send me a full year of Natural History at the low rate of $15 for 12 issues including Museum membership

☐ I want to save more. Send me 2 years of Natural History (24 issues) which includes membership for only $26 (a $22 savings off the single copy price).

☐ New ☐ Renewal

Send gift to: J550

Name ____________ (please print)
Address ____________
City ____________
State ________ Zip ________

☐ Payment enclosed ☐ Bill me later
Charge my ☐ Visa ☐ MasterCard
☐ American Express

Account number

Name ____________ (please print)
Address ____________
City ____________
State ________ Zip ________

Gift card to read ☐ 1 year $15 ☐ 2 years $26

Signature ____________

Moneyback guarantee if not satisfied.

Please add $5 per year for postage outside the USA. Payment must be included.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

POSTAGE WILL BE PAID BY ADDRESSEE

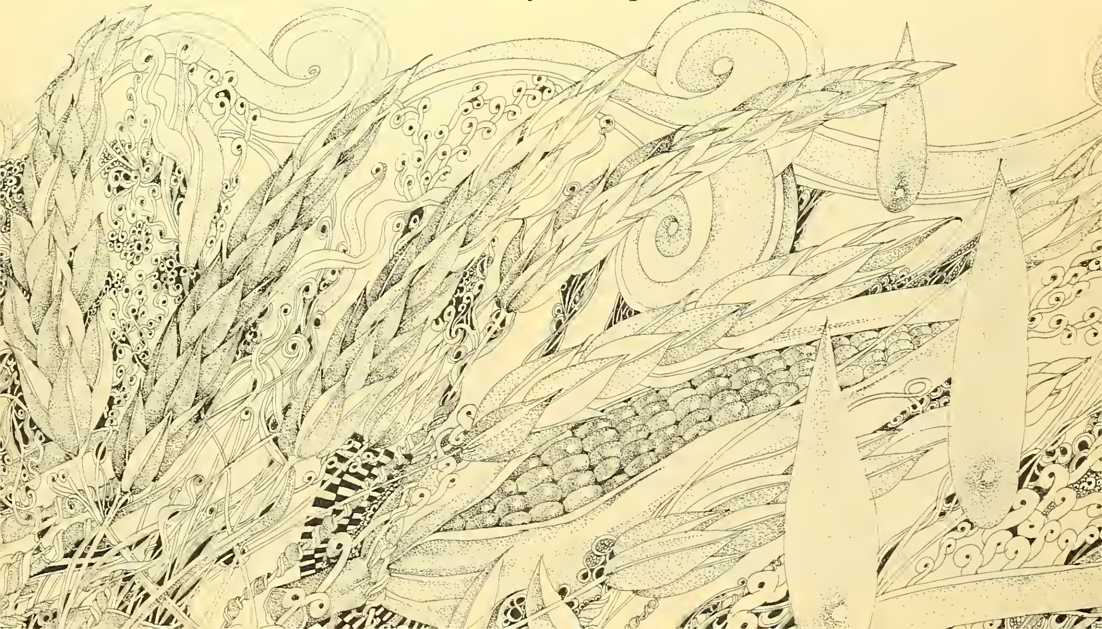
NATURAL HISTORY
P.O. Box 4200
Bergenfield, N.J. 07621

Human Wants and Misused Lands

A decade after the United Nations Conference on the Human Environment, attention is shifting to the need to combine development with ecological protection in the Third World

by Erik Eckholm

Illustrations by Jim Spanfeller



Plato lamented the destruction of soils and forests in ancient Greece. Dickens and Engels wrote eloquently of the wretched conditions spawned by the Industrial Revolution. But during the last two decades concern about environmental quality has surged and become widespread.

The U.N. Conference on the Human Environment, held in Stockholm in 1972, provided a focal point for the environmental concerns of the sixties. Inside the official conference hall, representatives of the world's governments passed a lofty set of principles and voted for new forms of world cooperation. Outside the official quarters, thousands of groups and individuals displayed, through their enthusiastic lobbying and debates, the mounting strength of citizen action on environmental issues as well as the diversity of views propelling it. An inflatable whale, paraded through the streets, symbolized what many saw as the needless destruction of nature. Crippled victims of mercury poisoning from Minamata, Japan, embodied the dangers of unregulated industrial technology.

Many in the Third World were initially skeptical, if not hostile, to the new devotion to the environment displayed by the affluent. Spokesmen for poor countries observed that their problem was too little, rather than too much, industry, and that some smoke in the air would be a small price to pay for lifting the multitudes from their gross deprivation. If we have environmental problems, such spokesmen said, they are a reflection of poverty: shantytowns where unsanitary conditions imperil health and degrade human dignity; forests razed and topsoil destroyed by the desperate, unskilled assaults of the needy.

Debating these issues during the preparations for the Stockholm Conference and after, Third World intellectuals helped broaden rather than repudiate the evolving environmental consciousness. The spreading awareness of the inescapable links between extreme poverty and the degradation of natural resources has been one of the most striking developments in environmental thought over the last decade.

Ten years ago, many Third World leaders were openly dubious about the relevance of environmental issues to their countries' development struggles. Today, such doubts are rarely heard, although it would be an exaggeration to say that all such feelings have been dispelled. Brazil, for example, some of whose representatives at Stockholm characterized the hue and cry about pollution as a plot to hamper the industrialization of the underdeveloped countries, founded a national environmental agency shortly after the Stockholm Conference adjourned. Scores of other developing countries have over the past decade created environmental ministries or agencies and passed laws to regulate pollution. And some now require analysis of the expected environmental impacts of major investments. Many in the Third World have learned through experience that unconstrained pollution can have savage effects without lifting the poor into affluence.

Third World governments have also been forced by events to notice a set of interrelated problems that in many ways present the world's premier environmental challenge. Famine amid the spread of desertlike conditions during a lengthy African drought in the early 1970s; landslides, disastrous increases in erosion, and flooding downstream of denuded hills in large areas of Africa, Asia, and Latin America; shortages and soaring prices for the firewood on which half of humankind depends for cooking and warmth—these were symptoms of the tragic cycle of degeneration undermining the livelihoods of hundreds of millions of the world's poor. Rapid population growth and lack of economic opportunities have pushed ever more people into "marginal" areas—desert fringes, mountain slopes, rain forest lands not suited to farming—where resource destruction may be the only feasible way of eking out a living. Some of the dispossessed migrate to urban slums and shantytowns, where they live amid environmental squalor of other sorts.

Over the last decade the convergence of ideas about environment and Third World development must be reckoned a historic advance for both fields. In the past, those concerned about the preservation of nature and those concerned about economic progress have often been at loggerheads. Recently, many on both sides have begun to realize that they need each other's insights if the goals of either are to be met.

The world conservation movement has for the most part focused on the need to protect endangered animals and to establish parks and preserves. But an animal cannot be saved apart from its habitat, and natural areas cannot last as fortress islands in seas of hungry people. Where large numbers lack a means to make a decent living, some are sure to invade national parks to grow food and cut wood. Desperately poor people cannot afford to worry much about what they see as useless tigers.

Instead of dwelling on the threat to the environment posed by development, many conservationists now recognize the need for economic growth as a prerequisite of successful conservation. But not just any sort of pell-mell, lopsided development; the key is economic progress that is ecologically sustainable and satisfies the essential needs of the underclass. Analysis of Third World conservation problems leads inescapably to concern for social justice. Broader sharing of the fruits of global development is important not only because it is morally right but also because it is crucial to the protection of natural systems.

Those involved with economic planning in the Third World have learned some lessons too. In general, modern air and water pollutants and toxic chemicals are less prevalent in developing countries. But most of these countries lack the technical personnel and institutional means for effective regulation of noxious effluents and dangerous products. Feeling the harsh pinch of economic backwardness, governments are often reluctant to apply strong antipollution standards to industries. Thus, around the industrial centers that do exist, pollution is often severe, harming nearby people and productive ecosystems alike. Workplace health hazards, scandalous enough in rich countries, are poorly regulated in most of the Third World. The overuse and dangerous handling of pesticides are widespread. Also, awareness is spreading that large-scale development projects such as dams and irrigation systems can, when carelessly planned, cause severe ecological backlashes, damages that offset many of the benefits of the investments.

In much of the Third World the destruction of the natural-resource base on which development depends has become obvious even to the ecologically illiterate. Expensive dams and canals fill with silt at twice the expected rate. Record floods wipe out crops and villages.

Adapted from the author's new book, *Down to Earth: Environment and Human Needs*, published by W.W. Norton in New York. Copyright © 1982 by the International Institute for Environment and Development.

Crop yields decline on overburdened soils. Climbing wood prices disrupt construction programs and put unbearable burdens on the poor. As a result, some planners have recently begun to incorporate an ecological perspective into rural development activities. But solving the interlocking crises of rural poverty and environmental degradation depends as much on politically contentious socioeconomic reforms as on improved planning.

The deterioration of natural systems in poor countries is at once a symptom and a cause of the extreme misery in which hundreds of millions live. The struggle to preserve global environmental quality is unavoidably intertwined with the struggle to improve the lot of the global underclass—the landless rural residents, the urban slum dwellers, and the tribal minorities who are the poorest of the world's poor.

The Global Underclass and Undernutrition

Worldwide, about 800 million people, nearly one-fifth of humanity, are so completely deprived of income, goods, and even hope as to put them in a special class. These the World Bank has called the absolute poor. Robert McNamara, who as president of the bank did much to focus world attention on this global underclass, described their conditions: "Absolute poverty is a condition of life so degraded by disease, illiteracy, malnutrition, and squalor as to deny its victims basic human necessities; a condition of life so limited as to prevent realization of the potential of the genes with which one is born; a condition of life so degrading as to insult human dignity." Roughly half the absolute poor live in the three South Asian countries of India, Bangladesh, and Pakistan. Large numbers live elsewhere in Asia, especially Indonesia, and in sub-Saharan Africa, with the remainder scattered among countries in the Middle East, Latin America, and the Caribbean.

Struggling week by week to survive, caught in endless cycles of hunger, illiteracy, exploitation, and disease, the absolute poor have little time to worry about global environmental trends. Yet in many ways they are more deeply affected by environmental quality than are the affluent. Most of the rural poor live directly off the soils, forests, waters, and wildlife whose deterioration has become the object of so much international concern. Many are forced by circumstances beyond their control to destroy the very resources from which they must scrape their living. In the cities, the poor live in squalor and are often the prime victims of industry's pollution, too.

Undernutrition is chronic among the underclass. In the mid-1970s, according to United Nations estimates, more than 400 million people—one-tenth of humanity—consumed less than the "minimum critical diet" below which health may be endangered. The ill effects of undernourishment are often nearly invisible. Outside of famine zones and refugee camps, overt starvation is uncommon. But chronic undernutrition can mean chronic health problems, a higher chance of death from disease at any age, heightened odds of mortality for mothers during childbirth and for their babies, and a reduced capacity for work. Routine diseases such as diarrhea and measles are routine killers among the undernourished.

For at least ten million people, nearly all of them children, the situation is quite visibly grim. Needing twice as many nutrients per unit of body weight as their elders do, growing children are particularly vulnerable to severe undernourishment. Children among poorer groups in much of Asia and Africa and pockets of Latin America and the Caribbean display the bloated bellies, emaciated limbs, and hollow stares of extreme nutritional distress. Community surveys have revealed that from 1 to 7 percent of preschool children in various developing countries weigh less than 60 percent of their expected level. Those who survive this wretched state face life with stunted growth and, according to some evidence, impaired mental capacities. Tens of millions more children suffer from less severe undernourishment that saps their resistance to disease.

If the proportion of the world's population that is undernourished is well below the popular conception that "half the world is starving," it still remains unconscionable because it is so unnecessary. According to UNICEF, a transfer of just 2 percent of the world's grain output to the plates of the poor would largely eliminate undernutrition. Yet one-third of the world's grain is fed to livestock and poultry each day. These numbers show beyond doubt that the root cause of today's hunger is not a global imbalance between the supply of food and the number of mouths to feed, but rather the unequal distribution of food or, more accurately, of money with which to purchase an adequate diet.

Redistribution of food supplies on the needed scale would not be as simple as it may sound. Two percent of the approximately one and a half billion tons of grain produced each year is no small quantity. Getting it to the right people at the right time would be well beyond political and organizational capacities in much of the world. Moreover, the ultimate impact of such massive food handouts on needed agricultural progress within the regions of hunger could well be negative, as farm prices and pressures for agrarian reform were reduced. Properly designed food aid, especially that aimed at mothers and infants, used for relief in emergencies, and used as wages for construction of infrastructure, has its place. But a central lesson of the last few decades has been that the hunger problem cannot be fully isolated from the basic problems of poverty and underdevelopment that are its source. The persistence of undernutrition in a world that produces ample food is only one of the consequences of global development patterns that leave hundreds of millions of people with no opportunity to be productive.

One thing is sure: the blight of hunger will not be banished from the earth if business continues as usual. A 1980 World Bank study of calorie deficiencies found that, although a continuation of historic rates of economic growth and income-distribution patterns would result in a reduction of the proportion of developing-country residents who would be undernourished in 1990, the absolute number would rise. Confirming what radical critics of the food economy have long been saying, the study concluded: "The normal course of development, even with a vigorous expansion in food production, is not likely to solve the nutrition problem." Nutritional data merely bear out what earlier studies of general economic trends revealed: under the conditions prevailing in most developing countries, the wait for the benefits of unregulated economic growth to trickle down to the poor is apt to be long if not altogether futile.

Even though agricultural progress in the developing countries is clearly not sufficient to eliminate hunger, it remains a necessary part of the solution. In the decades ahead many countries will lack the foreign exchange to import large amounts of food even if ample surpluses should be available on the world market. A broader development strategy that gives the poor the income to buy adequate diets will in almost every case be centered on agricultural development. Growing more food and giving more people the means to buy it should be part of the same process.

The food-production record of many developing countries over the last two decades has been fairly respectable. Since the early 1960s, output in Latin America and Asia has climbed faster than the population, resulting in a net increase in average supplies per capita. The extent to which the economic benefits of these sizable production increases have been widely shared, reducing the numbers of the hungry, varies by country. But a decline in per capita food output would almost certainly have seriously harmed the poor.

Unfortunately, just such a decline has occurred in Africa, where dismal agricultural performance and extremely rapid population growth have combined to reduce per capita food output by more than 10 percent over the last twenty years. In several African countries even the absolute level of food production has fallen under the impacts of agricultural mismanagement and ecological degradation.

Third World food demands rise relentlessly not only because of population growth but also because of rising incomes and changing tastes, especially in the cities. The net effect is steeply rising food imports for the developing countries as a whole—imports that are already draining foreign-exchange coffers and thus reducing opportunities for productive capital investments.

The technical potential exists for massive rises in Third World food production, particularly where water resources have not yet been harnessed for irrigation. But the costs will be high. By one recent estimate, investments in Third World agriculture must more than triple in the 1980s if the projected deficits are to be avoided—this at a time when massive new energy investments are also needed and foreign-exchange funds are less adequate than ever. Beyond the traditional investments in infrastructure and services, greater attention must be paid to watershed management, forestry, and soil conservation in order to safeguard the agricultural resource base, and new farming systems must be developed that depend less on fossil fuels.

As important as the scale of agricultural investment is the way it is spent. If agrarian reforms, smallholder progress, employment creation, and the spread of opportunities are stressed, hunger can be wiped out. If matters of equity are ignored, undernutrition will surely persist despite rapid growth in food production.

Spreading Landlessness and Ecological Degradation

Most of the world's absolute poor live in rural areas, and most of them are either landless laborers or people who lack secure access to enough farmland to support themselves at a decent level. Spreading landlessness is a root cause of many other ills, including runaway urbanization, uncontrolled international migration, mass underemployment, and the destruction of natural resources.

In the rural Third World today, the control of farmland remains the principal key to wealth and power. In the absence of widespread industrial growth, most rural residents must make a living in agriculture if they are to make a living at all. Yet perhaps 600 million people live in rural households that are either completely landless or that lack secure rights to adequate farmland. They are struggling to improve their lives through farming without control of the basis of agricultural life. Many sell their labor to more fortunate farmers for a pittance; others rent land at exorbitant rates under sharecropping terms that smother incentives for investment and innovation; still others scratch what produce they can from inadequately sized family plots and seek employment elsewhere to make ends meet.

Landless laborers, sharecroppers, and marginal farmers together constitute the majority of rural residents in most countries of Asia and Latin America, and they are rising in number in Africa, where land inadequacy has only recently begun to emerge as a major problem. These people, the dispossessed of the earth, have generally been bypassed by economic development and in some cases have been harmed by it. While the picture is by no means simple or uniform, studies in a host of countries—including Bangladesh, Indonesia, Malaysia, Pakistan, the Philippines, Thailand, and India—indicate that the incomes of many rural groups have declined in absolute terms over the last two decades, often in the face of considerable national economic growth.

Worldwide, the number of landless and near-landless people appears to be growing fast. Demographic pressures alone almost guarantee this: despite considerable migration to cities or foreign countries, rural populations in much of Africa and Asia are still growing at close to 2 percent a year. Even where they are feasible, land-settlement schemes cannot absorb more than a small fraction of the tide of potential farmers. The contribution of population growth to landlessness is often supplemented by other developments within the agricultural economy: land accumulation by better-off farmers; emergency sales of land by marginal owners; the spread of large commercial farms, sometimes foreign owned; and the eviction of tenants by landowners fearful of tenancy reforms or seeing a chance to profit from the use of new technologies. At the same time, economic policies in most developing countries have not promoted widespread nonfarm employment opportunities that could provide alternative livelihoods for agriculture's refugees.

Spreading landlessness manifests itself in many ugly ways. Obviously, it is a major link in the chain of circumstances that produces soaring rural–urban migration in many Third World countries (and illegal international migration as well). Those trying to cope with the afflictions of mushrooming shantytowns increasingly realize that the urban prospect may be hopeless if more is not done to spread opportunities in the countryside.

Ecological degradation is an even more alarming symptom of mounting landlessness. Lacking land or jobs in traditional farming areas, peasant farmers clear and plant lands that should never be farmed. They move into rain forests, destroying diverse ecosystems in what often turn out to be futile attempts at sustainable farming. Sometimes within sight of huge, underutilized agricultural estates in valley floors, desperate farmers plow up mountain slopes so steep that the topsoil washes away within a year or two.

In semiarid zones of Africa and Asia, land-hungry farmers plant in low-rainfall zones, which turn into dust bowls when the inevitable drought comes. Meanwhile, herders are squeezed into ever more restricted areas and the problem of overgrazing is intensified. The emerging inadequacy of the land base in relation to population and technology is often concealed by a form of involution: a steady decline in the soil-preserving fallow period.

The lopsided landholding patterns of much of the Third World are also inefficient economically. Other things being equal, large estates tend to produce less per unit of land than owner-operated small farms do. And in some areas, such as Bangladesh and parts of India, existing tenancy arrangements inhibit technical innovation. Where tenant farmers must buy all the materials and take all the risks, where they must give more than half their produce to the landowner and are moved about from plot to plot each year, the use of new seeds and fertilizers—let alone the expenditure of time on soil-conservation measures—is unlikely. In addition, a skewed landholding pattern contributes to unemployment. Everywhere, more labor is expended per unit of land on small farms than large ones.

The economic significance of broadly shared agricultural progress—of which the fairer sharing of agricultural assets may be a prerequisite—goes beyond the direct benefits in terms of produce and employment. With rising incomes and secure prospects, the rural poor demand simple consumer goods and farm implements, supporting the emergence of local industries and handicrafts. Productive, equitable agriculture and small-scale industry can reinforce each other, promoting a sustainable process of growth and a climate of progress in which people's receptivity to family planning may rise as well. Hence, because of the secondary and long-term benefits, agrarian reforms often make economic sense even where population pressures and land scarcity mean that land redistribution cannot provide plots to all who want them. Through their indirect effects on employment and industry, land reforms can ultimately help even those who do not receive land.

The effects of landlessness and grossly skewed land-ownership patterns on political stability must also be noted. Questions of land availability and distribution lie at the heart of recent political violence in Central America and portions of India; these examples provide a taste of things to come in many more places as well. Struggles for control over land and its fruits are certain to become more acute in country after country.

Reforms in land distribution, tenancy, and agrarian support systems; economic development patterns that provide broad opportunities to earn a reasonable income; a slowing of rapid population growth—all three are elements of a strategy to forestall the spread of landlessness with its myriad ill effects. And progress in each of these areas is linked to progress in the other two.

Slums and Shantytowns

The rural landless have their counterparts in the slums and shantytowns of Third World cities. Because the urban poor are much more visible and politically threatening, they tend to receive disproportionate attention from the media and politicians in comparison with the more numerous, and usually worse off, rural poor. Nonetheless, hundreds of millions of city dwellers live in abysmal environments.

That the urban areas of the Third World have been growing at a rapid clip is well known. Urbanization is one of the great social phenomena of the century, with the proportion of the world's people living in urban settlements rising from 14 percent in 1920 to 41 percent in 1980. In Latin America, as in the developed regions, the process is more advanced and more than half the population already lives in cities. In Asia and Africa the proportion remains lower; about 30 percent of the Third World's population now resides in cities. But about one-third of these live in slums and shantytowns.

Between 1970 and 1980, the urban population of developing countries grew by 4 percent a year, an increase of 320 million city dwellers over the decade. (Cities in the developed world grew at a rate of 1.2 percent annually.) This growth overwhelmed governmental capacities to provide basic services and to promote the construction of adequate housing. Slums and squatter settlements are the fastest-growing sectors of Third World cities.

If urban growth of 320 million during the last decade could give rise to such widespread official despair about urban prospects, not to mention so much human degradation, then what will be the consequences of the growth expected over the next two decades? The United Nations projects the urban population of the Third World to increase by more than one billion between 1980 and 2000. By the end of the century, sixty cities in developing countries will count more than four million residents each, eighteen of them more than ten million.

Substandard housing is the most obvious consequence of runaway urbanization. While data are hard to come by, available information suggests that in most developing countries housing conditions deteriorated in the 1970s. Most cities face gross shortages of low-cost dwellings at the same time that high-priced housing lies vacant and urban land lies idle. Even government-subsidized "low-income" dwellings are too expensive for large numbers of people.

In response, some crowd into inner-city slums. Housing occupancy in the West is measured in terms of rooms per person; in the Third World it is measured in terms of persons per room. Forty percent of India's urban population lives in one-room houses containing an average of 4.6 people; more than half the families in many Nigerian cities occupy one room. Half the urban houses in Indonesia contain more than one family. Overall, it is not uncommon to find four or five people living in each room of old tenement buildings in Third World cities.

With the old slums overflowing, huge numbers of people become squatters on vacant land or buy illegally subdivided plots and build their own dwellings—anything from tarpaper shanties to sturdy and livable structures. The most disadvantaged people tend to wind up on dangerously steep hillsides or in flood zones, where natural hazards join overcrowding and lack of sanitation to endanger health. Because they live in illegal areas, squatters are seldom served by convenient water connections, let alone sewage-disposal facilities or garbage collection. In many cities they pay exorbitant rates for water that is carted in by private vendors, and thus end up paying more per unit for this basic need than do the rich. They are often victimized by severe air pollution and water-borne toxic chemicals.

In 1980, half of Mexico City's fourteen million residents lived in shantytowns with few basic services, and 10 to 15 percent lived in overcrowded central-city tenements. As of 1975, four-fifths of the 650,000 people in Guayaquil, Ecuador, lived either in substandard slums, in shacks built over swamps, or on land subject to frequent floods. In the Philippines in 1979, four million urban dwellers were crammed into slum buildings or lived in squatter settlements.

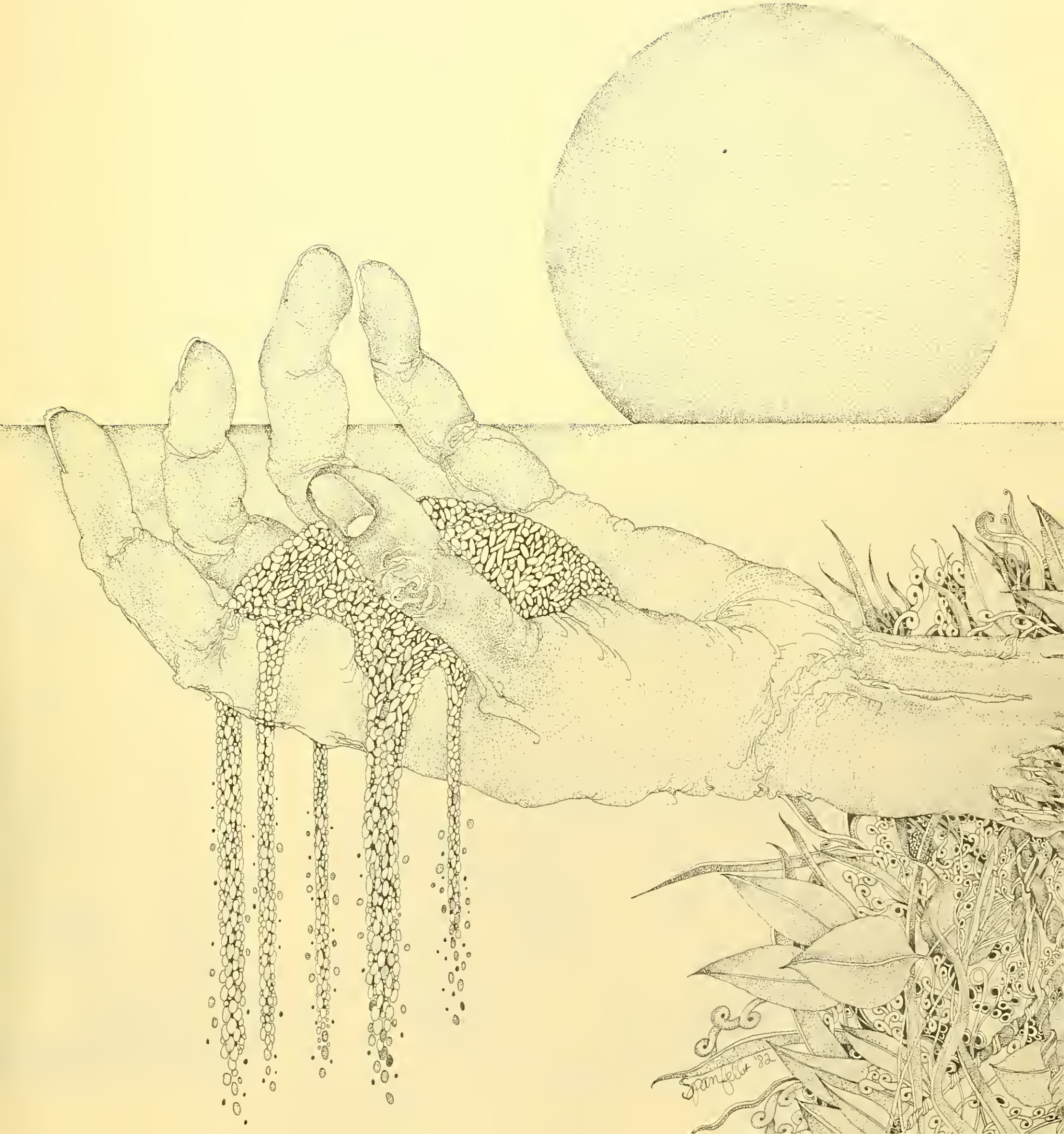
While major shifts in government programs and priorities within the cities are called for, many analysts doubt whether Third World cities can withstand the pressures projected for the coming decades. Realistic projections of industrial growth do not provide hope that modern jobs will open up on anywhere near the required scale. The combined cost of food, fuel, and water is becoming unbearable for many of the urban destitute, and the prices of such goods seem destined to keep rising. In many countries the effort to meet these minimal needs is inflicting broader social costs as well, as food and oil imports soar and precious forests are razed to supply fuelwood or charcoal to urban residents. A shift in development priorities to the countryside—combining faster economic growth with more equity—may be the only feasible way to slow the wave of migrants. Regeneration of rural areas is the key to a better life in the cities as well.

Tribal Peoples

Tribal peoples constitute a significant and often ignored element of the global underclass. Although a precise definition of the term is elusive, tribal peoples are ethnically distinct populations that in many cases live in geographical and political isolation from the dominant society. Many still practice some form of sustained-yield, low-energy agriculture, such as shifting cultivation or nomadism, or they live by hunting and gathering. They tend to have little political power and little chance to participate meaningfully in the decisions that determine their fates.

They differ from the rural peasantry in their comparative lack of integration into the national economy and their identification with a separate, traditional religion and leadership. Their land needs for subsistence and cultural survival are much larger than those of peasant farmers. As tribal peoples' contacts with the dominant society increase, the conditions of those who survive tend more and more to resemble those of the nontribal peasantry and the urban poor. Because of their particular cultural and ecological vulnerabilities, however, tribal peoples require special forms of assistance and protection if interactions with outsiders are not to have catastrophic effects on personal and group well-being.

According to a recent estimate by Survival International, a London-based advocacy group, nearly 200 million people, or 4 percent of the global population, can be said to live either in isolated tribal cultures or those dominated by outsiders. This total includes such better-known groups as the remaining few million Indians of South America and the tens of millions of tribal people, mainly rain forest dwellers, living in Southeast Asia. In black Africa, where most people identify with a tribe, deciding whom to include under the label is difficult, but such groups as the nomads


Spanfeldt '82

of the Saharan fringes, the Pygmies of central Africa, and the Khoi-San peoples (Bushmen) of southern Africa are included in the list.

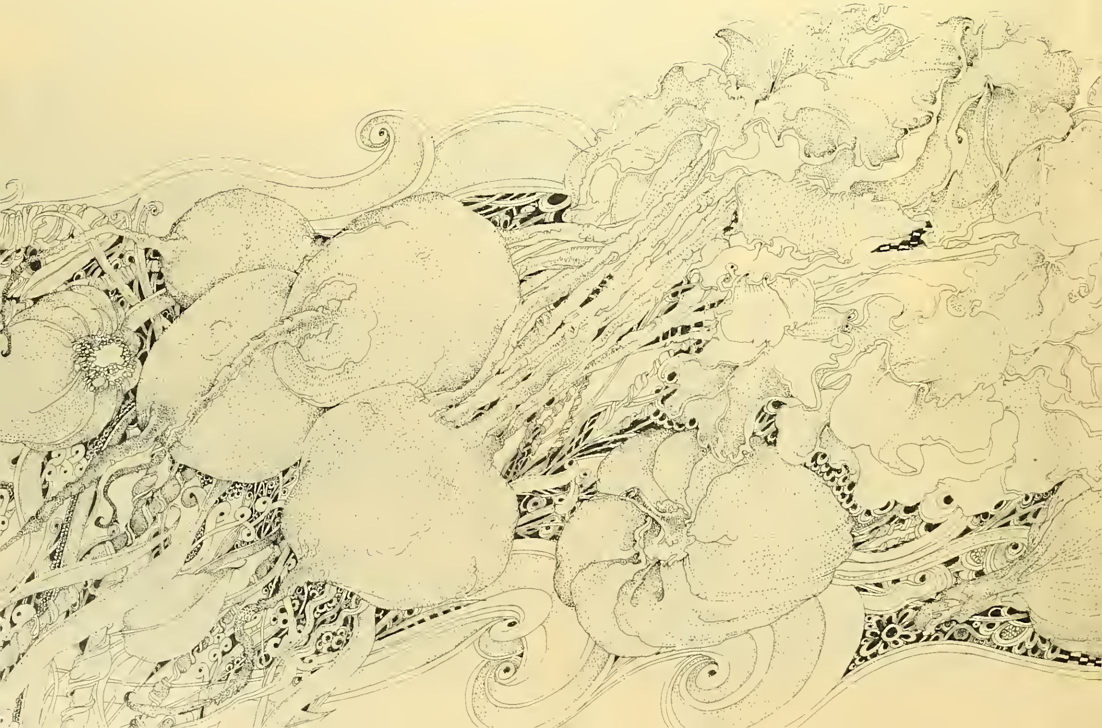
Some of the more numerous tribal peoples are not well known internationally. In India, for example, about forty million people are ethnically and culturally distinct "tribals," and they generally share the bottom rung of the socioeconomic ladder with the "untouchables," the lowest caste in the prevailing Hindu culture. Thirty-six million in China, twenty-two million in the Soviet Union, and one and a half million in North America live in tribal cultures.

New tribes are still being discovered in the Amazonian and Southeast Asian rain forests. One small group contacted in the Philippines in the 1960s, the Tasaday, was so totally isolated that it used Stone Age technology. Road-building crews in the Amazon Basin still come across previously unknown tribes. And even today, some tribal groups are being physically decimated as a result of the intrusion of modern civilization. Occasionally by the design of those who covet their lands, but usually because of the callousness of governments, corporations, colonists, and even missionaries, tribes fall prey in appalling numbers to violence or to simple infectious diseases to which they lack resistance. "Protected" tribal lands are often demarcated and redemarcated according to the convenience or greed of others. Development projects that affect tribal lands—commonly hydroelectric dams, mining schemes, and large-scale agricultural enterprises—are often pursued in a manner insensitive to the basic rights and needs of the native inhabitants.

For native peoples, integration with the dominant culture generally means new forms of hardship and degradation. They tend to become the lowliest of laborers, often on plantations or in timber industries, drawing on the very natural resources amid which they historically lived. Some wind up in city slums and work as servants or prostitutes. As their isolation is reduced, tribal people undergo what Latin American social scientists have called marginalization, a transition from a state of isolated independence to one of exploited dependence.

Culturally they fare little better. Where physical extinction no longer threatens, cultural extinction remains a constant possibility. Missionaries and insensitive educators, along with modern technologies and communications, can destroy the traditional culture without providing a workable new spiritual basis of existence. Tribal people are often pressured to adopt the traits of the dominant culture, but they remain despised and the objects of severe discrimination even when they do so. Alcoholism, mental disorders, and social disintegration are the common fates of "acculturated" native people. Many lead lives of dependency and despair on reservations; others may disappear into the ranks of the rural and urban poor.

The destruction of indigenous cultures entails major costs for global society. The irretrievable loss of diverse traditions, philosophies, and languages certainly impoverishes human culture and our potential knowledge of ourselves. But the costs are in the material realm as well. Having mastered the art of survival in what are often harsh, marginal environments, tribal cultures constitute a priceless and unique repository of ecological knowledge. Modern scientists have hardly begun to learn about the qualities of the plants, animals, and soils of the rain forests and deserts where so many of the remaining tribal peoples



live. Medical researchers have only recently appreciated the likelihood that numerous useful drugs will be discovered through the investigation of native medications. And undoubtedly, many new sources of food and other economically useful products remain to be discovered in the rain forests. Untold thousands of tropical plant species are known to native peoples but not yet to modern scientists.

Even more valuable than their intricate knowledge of particular species may be the understanding of the dynamics of ecological systems that some tribal peoples have. Modern man has not had great success in finding sustainable ways to use the rain forests and the desert fringes. Many of the native dwellers of these zones have, by necessity, developed a sensitive understanding of the ecological interdependencies and seasonal variations, and know how to exploit the land without destroying it. But the ecological knowledge of tribal cultures, most of which lack written languages, is seldom recorded on paper. It is passed by word of mouth. As the culture disintegrates, the accumulated knowledge of centuries is lost to humanity forever.

The issue is not whether the dominant society should decide to preserve tribal cultures in a pristine and isolated state, although this option should be available to particularly remote groups that choose it. Rather, the question is whether tribal peoples will be given more control over a process of evolution and integration that at best is bound to be extraordinarily painful and conflict ridden. With basic protection against land-grabbing, violence, and economic exploitation, and with institutions of government that allow self-determination, tribal peoples can work out their own paths of adaptation, and do so with a dignity that is too often denied them.

Damaged Lands and Human Costs

The reinforcing impacts of natural resource depletion and human destitution are exemplified by trends in the world's farmlands. The impairment or loss of arable soils plagues both rich and poor countries but the human consequences are harshest among the underclass.

As a result of population increases, rising global demand

for agricultural products, and unequal access to land and jobs, hundreds of millions of the world's poor try to farm lands that are not suited to this purpose or that require special protective measures if their productivity is to be maintained. Meanwhile, even prime farmlands in both rich and poor countries are badly managed; they are seldom protected from urban sprawl and often farmed in ways that undermine future fertility.

World agricultural production has, to be sure, risen dramatically in recent decades. In all continents save Africa, food production has risen faster than population growth. Nearly everywhere the potential exists for substantial further gains in crop yields despite land degradation and losses. But regional or global production figures provide little solace to those on marginal lands who see the basis of their livelihoods wash away. And declines in the quality of cropland mean higher costs for producing a given amount of food. As the land's natural productivity is diminished, future requirements for investment in land and water development and fertilization rise. Today's market signals do not fully reflect the long-term economic and social costs of cropland degradation.

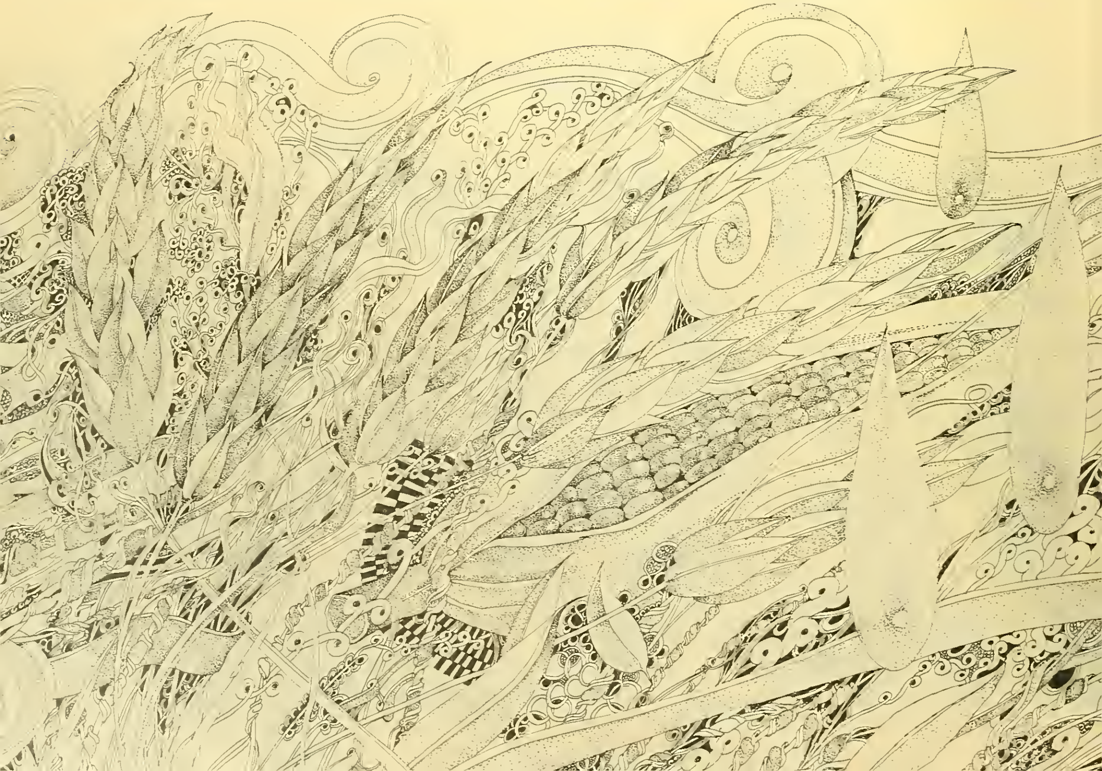
Erosion in the Third World is poorly documented, but available studies suggest that it is of mammoth—and rising—proportions. In the tropics, rain tends to come in violent downpours that rip away topsoil that has been left vulnerable. Gaping man-made gullies blight the hills of much of Asia, Africa, and Latin America. In dry zones, desperate farmers plant areas that should be left in pasture; the topsoil becomes airborne with the first windstorm. As populations rise in the absence of progress with agricultural technology, the fallow cycles that traditionally conserved the land are squeezed. Soil nutrients and organic matter disappear, crops fail, and the soil washes or blows away.

For national governments and international agencies, soil degradation is an especially elusive problem; even where its dimensions and implications are recognized, effective measures to reverse the negative trends are rare. Unlike such other environmental threats as ocean dumping or the release of ozone-destroying chemicals into the air, soils cannot be protected by national fiat or international treaty.

Soil degradation results from the actions of millions of farmers, each responding to particular economic incentives. Farming techniques that hold erosion to tolerable levels are usually available but farmers may not know about them or may not be able to afford them. Tenant farmers have no strong reason to protect the land in any case. Government policies to change incentives and promote conserving technologies are essential, but difficult to design and pursue. The protection of prime farmland from conversion, too, is often beyond the practical reach of national governments because land rights are bound by complex laws and traditions.

Much of the severe degradation of the Third World's marginal lands is rooted in trends the individual farmer can do little about. When economic development patterns and population growth force legions to farm lands that ought to be left in pasture or forest, efforts to disseminate antierosion technologies may well be futile. The remedies lie outside the scope of on-farm technologies.

In recent years, the international community has made a special effort to confront land degradation in the world's drier zones. A set of arid-land trends known collectively as desertification imperils many of the world's poorest people



and became the subject of an unusual world conference in 1977—the U.N. Conference on Desertification, held in Nairobi, Kenya. That meeting and its follow-up provide a useful case study of the constraints on, and opportunities for, international actions to help ease the critical natural-resource problems of the Third World.

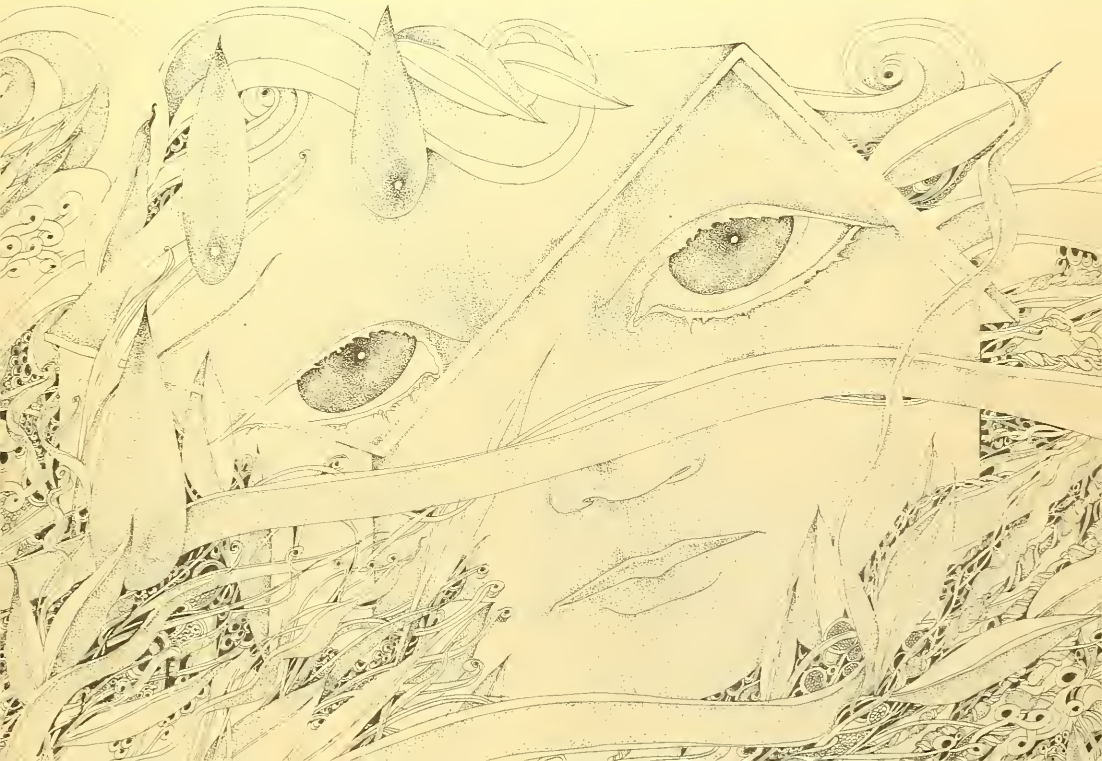
The catalyst for the conference was the well-publicized human suffering in the Sahel, the huge region just south of the Sahara, where years of drought culminated in widespread crop failures and livestock deaths in 1972 and 1973. Even as they rushed in famine relief, development experts began to realize that forces much deeper than a drop in rainfall were undermining the region's well-being. The development patterns of recent decades, they began to see, were out of kilter with the zone's ecological limits, causing a degeneration of the natural-resource base and a rising vulnerability to drought.

As awareness of the Sahel's problems spread, those concerned about resource degradation in other semiarid parts of the world also began to get a hearing. Ecologically unsound development, it became clear, was jeopardizing the livelihoods of scores of millions of people living in the world's drier zones and was whittling down the potential economic contributions of huge areas in developed and developing countries alike. The tragedy of the Sahel pushed to the forefront of global attention a set of complex, enduring problems whose breadth had scarcely been hinted at before.

One-third of the earth's land surface is arid or semiarid. Where rainfall is near zero and other water resources are lacking, the land is usually devoid of humans. But many semiarid lands can be surprisingly productive. Skillful herdsmen and farmers can eke out a living from quite hostile desert environments, and a fortunate few derive wealth from oil and other minerals below their desert sands. All told, close to 700 million people live in arid or semiarid zones. Some 62 million of these live directly off lands that are turning to waste.

Recent studies have revealed the enormous scale of the economic losses and human suffering associated with desertification. The U.N. conference considered three major categories of dryland problems. The first, rangeland degradation, usually involves severe erosion and a conversion of vegetation from nutritious perennial grasses to weeds that even goats cannot eat—the results of overgrazing and depletion of tree cover for fuel and building materials. The second category concerned rain-fed croplands that lose productivity as topsoil, nutrients, and organic matter disappear, often because of a decline in the soil-restoring fallow period or after plowing without suitable erosion controls. The third category involved falling yields on irrigated fields, as inexpert water applications and inadequate drainage lead to rising salinity, alkalinity, or waterlogging.

The actual losses can only be surmised. Scientists contributing to the preparations for the 1977 U.N. conference estimated that roughly fifteen million acres of formerly productive land were going out of production each year because of desertification in its various forms. Since then, Harold Dregne, a soil scientist at Texas Tech University in Lubbock, has tried to measure the losses more comprehensively, estimating the area of agricultural land deteriorating to the point where it yields zero or negative net economic returns. He calculates that each year



©1973
Spanfeller

roughly fifty million acres (an area the size of Senegal) decline to that point—this involves more than one million acres of irrigated land, nearly forty-five million acres of rangeland, and almost five million acres of rain-fed cropland. The quality of life for some of the world's most excruciatingly poor people, in semiarid central Africa and in India's huge "drought-prone" areas, is getting worse as their land degenerates. Something similar happened in the midwestern United States during the Dust Bowl of the 1930s; in *The Grapes of Wrath*, John Steinbeck chronicled the desperate migration of thousands to a new life in California. But tens of millions in the Third World today have no California to head for.

Examining the extent of past and present desertification, Dregne estimates that the potential value of annual production foregone on damaged lands is over $26 billion, comparable to the 1979 GNP of Thailand or Colombia. This, then, is the invisible cost of desertification to the world economy.

While some areas of rangeland and cropland have been destroyed beyond the point of economically feasible restoration, most of the desertified areas could be profitably rehabilitated. Many semiarid lands show remarkable resilience, as demonstrated by the oft-noted resurgence of greenery when overgrazed wastelands are protected by a fence. Land restoration requires changes in the economic pressures and farming practices that produced the damage in the first place, and effective management of recovery programs. It also takes money. The U.N. estimates that at least $48 billion would be needed in developing countries over twenty years, an average of $2.4 billion a year, to rehabilitate all their damaged irrigation lands, half their afflicted rangeland and 70 percent of their impaired rain-fed croplands, and to stabilize sand dunes covering some five million acres.

Current global expenditures (including both international aid and local government funds) devoted to the fight against desertification in developing countries are probably less than one-fourth of that amount. In theory, significant increases in such funding will pay off handsomely, but in practice, the money needed has not been forthcoming. Why? For one reason, many of the largest expenditures are needed in the poorest countries, which cannot possibly tackle these problems without external financial and technical aid. And international assistance faces severe limits because of donor-country political reasons unrelated to the opportunities for cost-effective investments.

Secondly, the economic returns on land rehabilitation and protection activities are often spread over a long time and are low compared to those of alternative investments. Governments get most political credit for projects with quick, flashy returns, and bankers using conventional discounting methods have little interest in moderate returns thirty years down the road. Thus in the Sudan, for instance, further development of irrigated acreage along the Nile will virtually always look more attractive financially than programs to stabilize rain-fed farming. (That millions of people may be uprooted and the fertility of a huge chunk of the country badly impaired as a result of the neglect of rain-fed agriculture may suggest that blind adherence to conventional economic analysis has its drawbacks.) Similarly, in a region such as the Sahel, investments in export crops always look more attractive than efforts to intensify production of rain-fed crops in a sustainable manner. Hence the scandalous situation in which, even in the postfamine years of the late 1970s, no more than 4 percent of aid to the Sahel was devoted to improved production of the rain-fed crops that provide 95 percent of the region's grain output.

A major obstacle to greater investment against desertification is the difficulty of spending money productively. Occasionally, outside funds and off-the-shelf technologies can be used simply to fix a dune or install drainpipes below irrigated fields—and with good results. But desertification problems cannot usually be isolated from the complex web of local political, social, and economic forces. It is one thing to pay people to plant some trees, and quite another to gain public cooperation and control over animals in order to protect planted seedlings. Researchers can develop new seeds and rotation patterns for food crops, but where agricultural extension services are nonexistent, where government institutions are wholly oriented toward export crops, and marketing policies depress grain prices for the benefit of urban residents, rural land use is unlikely to be transformed. In short, desertification is seldom a technical problem that can be solved with an injection of knowledge and money alone. It is a problem linked to basic patterns of national life.

Spreading Deserts

Natural climatic changes can lead to the genuine expansion and contraction of deserts. But misuse of the land can also make it appear that the desert's edge is marching forward. Depletion of trees and grasses permits sand dunes to blow over fields or transforms pastures into sandy or stony wastelands. Many of the horror stories about the relentless southward drive of the Sahara in Africa, and the Rajasthan Desert's march toward New Delhi, have been greatly exaggerated. Still, huge expanses along the edges of these and other deserts have been laid barren. Aerial photos taken in northern Sudan in 1975 were compared with maps from 1958; in seventeen years, the line at which scrub vegetation gives way to treeless desert had shifted southward by about 55 to 60 miles.

By far the greatest losses to desertification have little to do with the "spread" of true deserts. On-site misuse of range or farmland reduces patches to desertlike conditions or causes less visible changes in the qualities of soils and vegetation that render them less useful to humans. The proper metaphor is a pox with spreading pustules.

Agricultural trends well below the desert's edge in Sudan's Northern Kordofan Province provide a good example of the real desertification problem. Livestock numbers in the province multiplied sixfold between 1957 and the mid-1970s, putting unbearable pressures on grasses and shrubbery. Travelers stepping down from their camels or jeeps discover that what appears to be lush ground cover is no more than a tangle of thorny weeds that are inedible to livestock. As the population grows without a simultaneous transformation of agricultural technologies, the traditional cropping cycle, sound and sustainable when followed properly, is breaking down, resulting in crop-yield reductions and the outright loss of arable lands.

In the past, areas of land covered with *Acacia senegal*, a soil-renewing tree that also produces gum arabic and excellent fuelwood, were cleared and planted with millet, sorghum, maize, sesame, and other crops for from four to ten years. The depleted land was then left idle until the *Acacia* scrub reinvaded it; after eight years or so, the trees could be tapped for gum arabic, a valuable cash crop, for six to ten years. Finally, as the trees began to die, they were burned, and the cycle began anew. Now, pressed by necessity, farmers extend the cultivation period, depleting the soil and hampering the regrowth of gum arabic trees. Overgrazing, too, cuts the survival of young trees. These practices cause ever larger patches of land to become useless sand.

Two thousand miles to the west, on the Mossi Plateau of Upper Volta, degeneration of the land likewise provides a harbinger of things to come elsewhere in Africa. Here, as in many areas experiencing ecological decline, superficial appearances can mislead. Except where severe gully erosion blights the view, lightly wooded, usually grassy landscapes punctuated by millet fields are common.

But the grasses are mainly of inedible species. Most of the trees are disfigured; only those species that provide food, fodder, fertilizer, medicines, rope, or other essential products have been left standing, and closer inspection reveals regeneration of these valuable species to be spotty at best because seedlings are nibbled by goats or uprooted during cultivation. The "open spaces" turn out to be fully used. Nearly every bit of uncropped land is either lying fallow as part of someone's crop cycle, or has been abandoned because the soil is useless. "The soils are tired," say villagers throughout the region. With yields dropping, they must clear ever larger areas to grow enough food to survive. Young adults are lucky if they can get farming rights on steep hillsides or on less fertile lands. Fields are cropped repeatedly with no fertilizers to replenish their nutrients, no manure to help rebuild the thin topsoil. This is the way the wasteland spreads, not with a bang but a whimper.

In the context of the agrarian stagnation and extreme underdevelopment that prevails in Upper Volta, population growth catalyzes destruction of the resource base. Since the country has one of the world's highest death rates, its population is growing more slowly than that of most Third World countries; the natural increase is believed to be about 2 percent annually. But on the Mossi Plateau, given prevailing technologies, any growth in human numbers causes environmental stress. The density of humans overtaxes the capacity of traditional methods to extract food and firewood from the land on a sustainable basis.

Only migration forestalls more overt social and ecological distress. Mossi people are moving to the still-fertile, less densely populated south and west of Upper Volta, where land-use conflicts are erupting between newcomers and the original inhabitants and the same cycle of degradation looms in the future. A high portion of the country's young men have left to work in menial jobs in the economically vibrant Ivory Coast. The typical village is simultaneously overpopulated relative to current technologies and depopulated of the innovative individuals most likely to reverse the downward spiral.

Simply blaming the ills on population growth and expecting contraception to cure them is neither accurate nor realistic. In Upper Volta, as in much of Africa, the sorry state of affairs is the culmination of centuries of colonial and postcolonial development patterns that have failed to create a sustainable way for the majority to improve their lives. Where close to half of all children die and adult literacy is below 5 percent, expecting the wide and effective use of family planning in the absence of other radical changes is hardly rational.

A better future is possible for the Mossi Plateau and other similarly endangered areas, but it will depend on progress on many fronts at once. Farming systems that combine food production, forestry, and animal husbandry—systems that preserve soil fertility as they boost output, all with minimal reliance on imported fertilizers—are feasible but inadequately studied. Simple antierosion and water-conserving works on fields could raise crop yields dramatically. A comprehensive approach to development is essential, one that includes provision of primary health care, household water supplies, elementary education, agricultural improvements, forestry, and family planning. National commitments to improving the role of women must also be part of the solution; as the main farmworkers and as potential childbearers, women need the opportunity to innovate that is now denied them.

Sound development in the poor, rural societies suffering most from desertification must entail new forms of social organization in countless small, dispersed villages and among hard-to-reach nomadic groups. Implementation of a thousand small projects is harder than building a large irrigated estate or a factory; it requires reforms in the structures and attitudes of government bureaucracies as well as an overriding shift in national priorities toward equitable rural development, unavoidably at the expense of local elites.

In the Sahel and many other regions, the colonial quest for raw materials and the postcolonial quest for foreign exchange caused a near-total emphasis on export crops such as cotton and peanuts. Certainly, cash crops can play a constructive role in development, but too often the priority granted them by public policies has resulted in food shortages in times of drought, a vulnerability to declining international terms of trade, and ecological damage as the food-crop area is squeezed. Perhaps the most serious consequence of the export crop bias has been the associated neglect of research and infrastructure in support of agricultural systems for peasant farmers.

One of the most controversial aspects of desertification has been the role of nomads. In the early 1970s, immediately after the Sahelian drought, many observers blamed the nomads and their herds of cattle, camels, sheep, and goats for causing the spread of the desert. Drastically cutting herds was often seen as the critical challenge. In reality, the story is more complicated. Most nomadic groups, it turns out, have historically had prudent systems of grazing control, designed to take maximum advantage of available grasses without serious destruction.

But during the last quarter-century, the spread of settled farming has compressed nomads into smaller areas with less reliable rainfall and, together with the demarcation of national borders, has drastically limited their freedom to move about in response to changing pasture conditions. New boreholes have often disrupted traditional patterns of range sharing among tribal groups, resulting in severe overgrazing around wells. And improved veterinary services have enabled herd sizes to grow.

Livestock numbers and movements need better control, but the flexibility and ecological knowledge of nomadism must be built upon, rather than replaced. Those "experts" trying to develop workable range-management strategies—and this is a field best known for its failures—must also be sure to ask the right questions. Right, that is, from the point of view of herders as well as of governments. Officials, mindful of export earnings, ask how meat production and sales can be maximized without degrading the pastures. But the nomadic family may have other primary goals. How big does the herd need to be in order to insure large numbers will survive the next drought? And how many animals are necessary for meeting the social obligations imposed by marriage and other customs? The successful strategy will take account of, rather than ignore, the aspirations of the population that is supposedly being helped; pastoralists themselves must be involved in the design and implementation of range-improvement schemes. It may well be that only they can make productive, sustainable use of the life-defying desert fringes.

All the many political, economic, and cultural concerns herein discussed are part of the desertification problem. Case studies from other parts of the world reveal similarly complex pictures. The term desertification provides a useful conceptual entree into these webs, forcing particular attention to their ecological aspects. But desertification has limitations as a conceptual umbrella for the full range of actions needed to enhance human life in arid and semiarid lands. Halting the desert's spread is often not as simple as it once seemed to many and this has complicated the recent antidesertification efforts of the international community.

This is not to say that nothing has been done to fight desertification in the last few years. On the contrary—and in part because of the awareness sparked by the Nairobi conference—relevant new activities are under way in nearly all the afflicted areas. In arid-zone countries, ecological rehabilitation has overnight become a catchword among development experts, and national political leaders give speeches on the dangers of deforestation and soil erosion. External aid to the countries of the Sahel doubled between 1975 and 1979, with an increasing (although still grossly inadequate) share of it devoted to the improvement of dryland farming, grazing management, and forestry.

Positive as these trends may be, the degradation of productive lands apparently continues nearly unabated. The money and talent devoted to "antidesertification" activities are far from adequate, yet much of the existing investment is poorly used. Both the quantity and the quality of land-regeneration activities must rise in the coming years if further human suffering is to be minimized. Desertification is a symptom of development gone awry. Direct actions to combat the symptoms are certainly necessary but deeper political and economic reforms are essential if there are to be lasting benefits.

Prospects for the Future

A survey of global environment trends since the Stockholm Conference yields good and bad news. On the positive side, public understanding of environmental imperatives seems to have increased over the last decade and needed new institutions have evolved. On the other hand, many of the social, economic, and technological forces that underly environmental difficulties have scarcely been checked.

Appreciation of the material and spiritual importance of a healthy natural environment has spread. Perhaps the most dramatic intellectual shifts are occurring in the Third World, where understanding of the ecological underpinnings of human life—largely lost in the postwar dreams of industrialization—is on the rise. The new interest in environmental quality complements recent shifts in thought among development theorists, many of whom now stress the need to address the basic needs of the poor directly rather than hope that the benefits of growth will trickle down to them. Improving the lot of the underclass and protecting environmental quality are mutually supportive goals.

Both internationally and within nations, the new appreciation of our bonds with nature has spawned new institutions and policies—new United Nations and governmental agencies, new laws, altered aid programs, new international treaties. Yet for the most part, responses remain inadequate to the needs.

More than anything else, the stone wall of inopportunity facing the poorest billion or so people insures the continuing degradation of natural resources in large parts of the world. The slowed economic growth already apparent in the 1980s means that any potential downward trickle of benefits has slowed to a drip. Even the sometimes dazzling growth of the last quarter-century left a huge underclass with little chance to better their lives. An unknown but significant number are worse off now than before. In the absence of wider economic and social reforms, efforts to protect wildlife and forests, to manage watersheds and arid lands, to clean up urban shantytowns and waterways, will never be fully successful.

Nor are birth rates apt to fall quickly among people who see many of their babies die. Despite the dramatic slowdowns in population growth in developed countries, in China, and in a few other places, the world demographic outlook remains menacing. Not only are human numbers projected to more than double in little more than a century, but also the increases will be concentrated in some of the poorest regions.

What will happen to the African landscape if, as is now projected, the population there quadruples over the next one and a half centuries? What will conditions become in Latin American cities, already reeling from immigration, if the region's numbers triple? Where will the extra 3.5 billion people projected for Asia—an increase equal to the entire world population of the late 1960s—find food, fuel, and shelter? The earth undoubtedly possesses the technical potential to sustain the projected increases. But realizing it will require improbable degrees of social organization and global cooperation. The natural environment, and thus the quality of human life, will suffer grievously as societies struggle to cope with multiplying numbers.

Energy choices have major implications for the environment. The seemingly unlimited availability of low-cost oil and gas up to the early 1970s fueled the automobile explosion, but also held down coal burning. Urban air benefited greatly, and acid rain did not spread as rapidly as it might have. Renewed reliance on coal by utilities and factories seems likely to undo recent gains against air pollution and to acidify the rain over wider areas. Major commitments to coal and coal-based synthetic fuels probably also amount to acceptance of human-caused climate changes in the middle of the coming century—changes that are bound to cause hardship for the underclass at least. Another major energy alternative, nuclear power, carries its own unresolved problems of safety, waste disposal, and weapons proliferation.

In parts of the Third World, soaring oil prices have exacerbated the scarcity of fuelwood. Kerosene, traditionally the main wood substitute, has been pulled further out of reach of the poor. Villagers in a few places have actually been forced backward in history as the high price or unavailability of kerosene requires them to switch back to wood for cooking their meals and warming their homes. Whether tree-planting programs and alternative energy sources can be provided quickly and widely enough to avoid massive landscape damage and social hardship remains to be seen.

The increased use of renewable energy sources should reduce energy-related environmental damage. But governments have not yet granted renewables the same research support and subsidies they give other energy forms, especially nuclear power, thereby missing a chance to hasten their availability. Still, biomass production and large-scale hydropower development can cause significant damage to land and people if not properly managed. Increasing the efficiency of energy use remains the most environmentally benign response to the energy challenge, one not yet fully exploited anywhere.

The poorer countries desperately need financial and technical aid to help them confront the interlocking cycles of poverty, resource degradation, and rapid population growth. Enormous sums are required if clean water is to be provided to a higher proportion of humanity, if woodlots are to be planted on the necessary scale, if small-farm food production is to be multiplied as it must, and if family planning services are to be made available to all now lacking access. Third World countries also need help to develop the technical capacity to regulate pollution, the handling of toxic chemicals, and occupational safety.

Virtually all Third World countries are now undergoing wrenching technological and social transformations that pose huge ecological dangers. With so many people subsisting on the bare margins of life, these countries cannot afford to repeat all the ecological errors of the developed countries or to provoke the severe ecological backlashes that are peculiar to tropical conditions. Building institutions for environmental analysis and regulation, and for improved natural resource management, is no less important in poor than in rich countries.

Technological change, the seeming source of many environmental problems, is sometimes also touted as the key to their solution. Potential research breakthroughs that could make a difference can certainly be identified. Cheaper solar power, cheaper and more effective ways to remove poisons from smokestacks and tailpipes, more reliable and safer contraceptives, hardier and faster-growing trees—the list could go on and on.

Still, few serious challenges will be resolved through technological progress alone. Appropriate social organization is usually the primary need. Higher-yielding crops can contribute to the battle against hunger but will not automatically mean more food for the hungry; reforms in the distribution of assets, services, or employment are essential for that. Better contraceptives are badly needed. Yet unless their economic prospects improve, many among the underclass will continue to have little interest in family planning. A simple, low-cost method for treating the effects of severe diarrhea—a major killer of infants and small children—that was recently developed will save many lives. But unless health-care systems are reorganized, many rural children will not receive even this treatment. And only access to clean water, together with improved sanitary habits, will cut the awesome incidence of diarrhea and other infectious diseases.

In this context, global spending on weapons research and arms, now surpassing $500 billion a year, soaks up resources needed in the fight for a more sustainable world order. Vital research frontiers go unexplored. Something is wrong when the world is incapable of raising $80 million a day to provide clean water to all people, but lays out $1.4 billion a day on weapons.

Our understanding of the influence human culture has on the biosphere and of the influence the biosphere has on human culture is deepening over time. In this inescapable relationship we have come to call the troubled points "environmental problems." The biosphere seldom presents human society with imperatives; rather, we face choices about what sort of world we want to live in. Responses to environmental threats can be formulated only in relation to broader human goals. The issue is not whether societies can adapt to further environmental degradation, but what the price of doing so will be.

Civilization could undoubtedly survive the extinction of elephants and orchids, but the world would be spiritually as well as economically poorer. Civilization has for centuries accommodated a vast underclass living in extreme poverty and amid extreme environmental degradation. That some forty thousand infants and small children die unnecessarily each day as a result leads many people to work for reform of the global social order.

Environmental choices must be guided by a vision of a desirable human society and of the quality of the natural environment needed to support that vision. In the struggle to create a more decent, a more human world, the environment is gradually receiving its due respect. That may be the real legacy of the Stockholm Conference. □

Give a GIFT of NATURAL HISTORY

Give one at $15 and save 20% on subsequent gifts at $12 each

Give 12 beautiful, thought-provoking issues of Natural History to someone special. This year-long gift is appreciated by discriminating and intelligent people, and is inexpensive and easy to order. Just send this postage paid card with your order today.

☐ YES, send ______ gifts, which include 12 thought-provoking issues of Natural History and all the benefits of a one-year Associate Membership in the American Museum of Natural History. (Save 20% on all additional gifts)

J573

GIFT FROM:

Name ______
Address ______
City ______
State ______ Zip ______

☐ 1 Gift a $15 $15
☐ Additional Gifts at $12 ______
(20% savings)

Total Enclosed $ ______

☐ Payment enclosed ☐ Bill me
Charge my ☐ Visa ☐ Mastercharge
☐ American Express
Account number
☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Signature ______
Outside U.S.A. please add $5 postage.

GIFT TO:

Name ______
Address ______
City ______
State ______ Zip ______
______
Gift card to read

GIFT TO:

Name ______
Address ______
City ______
State ______ Zip ______
______
Gift card to read

Moneyback guarantee if not satisfied

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

POSTAGE WILL BE PAID BY ADDRESSEE

Natural History
P.O. Box 4200
Bergenfield, N.J. 07621

Give the gift that's perfect for any occasion

NATURAL HISTORY
$2
11/80
6/81

Send 12 beautiful and thought-provoking issues of Natural History to someone special. Natural History is the perfect gift for any time of year...a gift that keeps giving all year long. Your special someone will receive a membership card that will entitle him to all the benefits of Associate Membership in the American Museum of Natural History (see list at right). We'll send a handsome gift card to announce each gift. For only $15 per year, you can say so much for a birthday, anniversary, or any special occasion. Call the toll free number as listed below or use one of the postage-paid Natural History reply cards in the Magazine. Give the gift of Natural History today!

Your Gift brings all these Benefits:

- A one year subscription to Natural History (12 issues)
- Free admission to the American Museum of Natural History
- Access to the air-conditioned Members' Lounge
- Travel opportunities led by Museum scientists to all parts of the world.
- Discounts on artwork, books, crafts, jewelry, and other gift items from our Museum shops and gift catalog
- Admission to special features and programs
- A valuable membership card
- Discounts on car rentals, other services
- Free ticket to our NatureMax Theatre

To Order: CALL TOLL FREE 800-247-5470
(In Iowa) 800-532-1272

Or Write: Natural History Magazine
Membership Services
Box 4300
Bergenfield, N.J. 07621

AMERICAN MUSEUM OF NATURAL HISTORY

How Mule Deer Mate in Texas

The type of mating system used by these deer is greatly influenced by social factors and the habitat they live in. In Texas, the bucks court and tend their does

by Thomas E. Kucera

The mule deer of western North America is one of our most common large mammals. Ranging from southeast Alaska to Mexico, the species occupies a variety of habitats, from dense, wet coastal forests to high summer ranges to arid desert lowlands. Much is known about its general ecology and management, but less material is available describing and analyzing its social behavior in the wild.

An understanding of the social behavior of animals can lead to a greater understanding of the ecology of a species. Many aspects of social behavior are directly related to an animal's habitat. Open habitats, for example, make living in groups advantageous for many animals. This type of sociality is explained by the "selfish herd" concept, elaborated by W.D. Hamilton, which holds that in the absence of cover an individual's best protection from a predator is to live in a group and put other group members between itself and the predator. Dale McCullough, a student of ungulate social behavior at the University of California, has hypothesized another relationship between the habitat and behavior of ungulates: specifically that the degree of openness of the habitat influences a species' mating system. This relationship can be seen in four members of the North American deer family.

Moose, in their densely vegetated habitat, are typically solitary. The sexes associate only during rut, the annual period of sexual excitement, when a bull seeks a receptive cow and stays with her until mating, after which he seeks another female. This is a "tending bond" system and contrasts with the harem system of elk, gregarious inhabitants of more open areas. Bull elk gather groups of as many as several dozen cows during rut and defend these harems against rival bulls. Both the tending bond and harem are polygynous systems, in which a successful male can inseminate several females. The essential difference is that in the tending bond, which is associated with dense habitats, individual females are tended and each is free to move as she wishes. In the harem system, typical of more open areas, females are herded into a group, or harem, which is maintained by the master bull and defended against rivals.

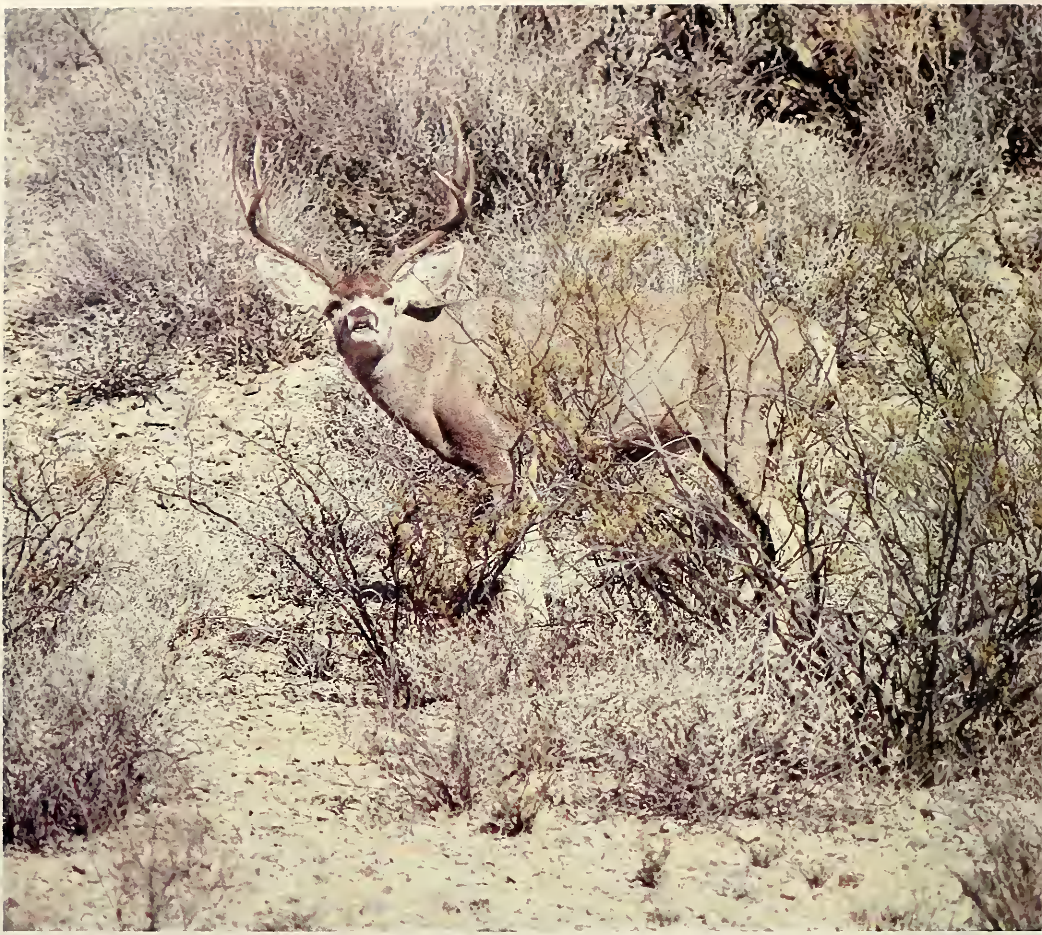
White-tailed deer, whose typical habitat is densely wooded, are normally asocial, and exhibit tending-bond behavior during rut. But work by David Hirth, now at the University of Vermont, on white-tailed deer living in the relatively open environment of the Welder Wildlife Refuge in south Texas has revealed a gregariousness that had not been observed in the forest-dwelling deer. Hirth also observed dominant bucks chasing other males away from groups of does, although no harems were formed and the estrous doe and tending buck always separated from the group. He specu-

Serious fighting between mule deer bucks is generally restricted to the largest individuals. The tuft of hair on the antler of the large male, left, resulted from a recent conflict. Young bucks, such as the one at right, have little access to estrous does.

Leonard Lee Rue III

Leonard Lee Rue III; Tom Steck and Associates

Thomas E. Kucera



lated that this may be the beginning of a harem system of breeding.

Mule deer typically live in more open habitats than do white-tails and, as would be expected, are more social. Published accounts of mule deer social behavior during rut are inconsistent with regard to their mating system. Several authors have described what sounds like harem formation; others have flatly stated that mule deer do not form harems. Given the variety of habitats that mule deer occupy, these inconsistencies are not surprising.

An aspect of the relationship between social factors and reproductive success is the relative contribution of different age and size classes of bucks to breeding. In a polygynous breeding system, most females reproduce, but relatively few males leave descendants, and the competition among bucks for females can be fierce. This is the explanation for the evolution of large body size and weaponry in males of polygynous species. The biggest males with the biggest weapons (antlers, in the case of deer) will be most successful in competing for females and will leave the most offspring, thus selecting for large body size and weapons. Among mule deer, the biggest bucks do most of the breeding, just as the most dominant bull elk are the ones to form and defend a harem of cows. Quantitative data to support this assumption, however, are rare.

This lack of quantitative information is partly due to the difficulty of making observations of mule deer in the wild. As a result of being hunted, these deer are rather shy throughout most of their range, and often occupy rough or

Having smelled the ground where a doe has urinated, a buck performs an act called flehmen, above, in which he retracts his upper lip, extends his muzzle, and turns his head from side to side. Scent from the doe's urine passes to an organ deep in the buck's nasal area, enabling him to determine her reproductive condition. The Chisos Mountains in the Big Bend National Park of Texas, right, formed part of the author's study area.

wooded regions with physiographic features that prohibit extended observations. Big Bend National Park in southwest Texas, where the Rio Grande makes its curve to the north, provides an ideal solution to these problems. Because no hunting is allowed in the park, the deer, although still wild and unapproachable, are not in great fear of humans, especially those in vehicles. Also, the vegetation and terrain in much of the park make observations of deer fairly easy.

At its lower elevations, Big Bend supports a large number of the desert race of mule deer, *Odocoileus hemionus crooki*. A subspecies of white-tailed deer, *O. virginianus carmensis*, lives in the moister, wooded uplands, but the two species have little overlapping range. This thriving herbivore population supports many predators, the largest—and probably of greatest concern to deer—being the mountain lion. The local abundance of this animal is reflected in the names of many sites in the park: Panther Peak, Panther Pass, and Panther Junction.

My observations, concentrated within a forty-mile radius of Panther Junction, were made at an elevation of about four thousand feet, where the vegetation is characterized by low-growing plants, many species of grass, and tall shrubs. This area was often ideal for watching deer. Harem breeding, if it occurs in mule deer, would be most likely in an open habitat such as this.

These deer were definitely social. During my study, 85 percent of all the deer I saw were in groups of at least six animals; more than one-quarter were in groups larger than fifteen. Although the individuals in these groups may change often, during most of the year the sexes do not mix: females live with other does and recent offspring; bucks live in bachelor groups or alone. This pattern changes during the rut, however; more than 90 percent of the deer I observed between mid-December and mid-January were in groups of mixed sexes.

Thomas E. Kucera

For most of the year, bucks have little to do but eat, sleep, and avoid predators. Does usually have the responsibilities of motherhood throughout the summer; bucks merely grow antlers and wait for fall. As day length shortens, the deer's antlers harden and the bucks become much more active, competitive, and aggressive. The necks of the biggest bucks swell noticeably, and dominance and other interactions among bucks become frequent. Bucks also become more attentive to does. In fact, by noting the change in frequency of certain behavioral acts, the course of the rut can be charted.

In addition to determining the breeding system these deer used, I was interested in which size classes of bucks were most involved in agonistic and courting interactions, and in relating size class of bucks to reproductive success. I classified bucks by the total number of points on the antlers. Although the correlation is not perfect, the biggest bucks generally have the greatest number of points. Sketches and mug shots of bucks were also made to aid in field identification.

As expected, the biggest bucks engaged in dominance and agonistic acts most frequently. In one of these acts, the rub-urination, a buck rubs his tarsal glands together and urinates on them (these glands are located on the inside of the hind legs). Rub-urination occurs when one individual is threatening or dominating another, and is performed most often by the largest bucks, those with antlers of nine and ten points or more.

In another behavioral sequence, a buck thrashes vegetation with his antlers, often to signal to a competitor his readiness to fight. This thrashing is commonly interspersed with rubbing the forehead on the vegetation, especially when no rival is present. Although performed by all size classes of bucks, the antler-thrash/forehead-rub sequence is also performed most frequently by the largest bucks.

Attempts to establish dominance are not just visual; olfactory signals are used as well. The use of scent is common among deer. The rub-urination, combining tarsal-gland secretions and urine, is thought to communicate both the identity and condition of the individual performing it. Individual identity is provided by the odor of the tarsal-gland secretion itself; physiological condition is expressed through the urine. A buck in good condition is metabolizing body fat and dietary energy. In poor condition, a buck metabolizes muscle tissue, and this results in different metabolic products in the urine.

The antler-thrash/forehead-rub sequence may also provide both visual and olfactory clues to other bucks that rivals are present. Work by D. Müller-Schwarze, a researcher at Utah State University, has shown that the forehead region of black-tailed deer, a subspecies of mule deer from the coastal forests and chaparral shrublands of the Pacific Northwest, is glandular and functions as a scent gland. Forehead rubbing among desert mule deer, which is performed most frequently by the largest males and often during male–male interactions, is most likely an expression of dominance. When combined with thrashed vegetation, this behavioral sequence can signal, both visually and olfactorily, the presence of an animal for several days.

Two other interactions among males, sparring and fighting, seem similar at first, but show some very basic and important differences. Sparring is a ritualized contest in which two bucks approach each other, lower their heads, and carefully join antlers. Each then begins to push forward, twisting his head and apparently trying to drive his opponent back or push him off balance. Sparring matches are usually terminated when one of the participants turns

Leonard Lee Rue III

In a tending sequence, a dominant buck will follow an estrous doe, above. When a doe stops to browse, left, the buck sniffs and licks her perineum. He will then slide his chin over her rump and, finally, mount her. Courting bucks are so persistent that, at times, the does appear harassed.

Thomas E. Kucera

and moves away or browses. The victor rarely gives chase; often there is no obvious victor. These matches are frequently made up of "rounds," sparring encounters lasting up to a minute and separated by ten- to thirty-second intervals of browsing, resting, or a form of behavior I call profiling. During profiling, sparring bucks disengage antlers and lift and turn their heads laterally, as if giving the opponent a profile view of the head and antlers. Similar acts have been noted in other ungulates.

In contrast to other male–male interactions, sparring frequency decreased as the rut progressed, and then increased as the rut waned. Sparring was most frequent among the smallest bucks—the yearling and three- and four-point classes—and matches often involved deer of different sizes. Of the eighty-six sparring matches observed, 70 percent involved deer of different size classes.

Serious fights are much more violent and less frequent than sparring matches, are usually of shorter duration, and involve large individuals from similar classes. Fights are generally preceded by the rub-urination and antler thrash, or a crouching and circling approach in which the head is held low and the ears pressed back. If neither individual backs down from these threats, a sudden, fierce clash occurs; the combatants rush at each other, violently join antlers, push and twist. Although I saw no serious injuries occur during fights, I am convinced that this is solely due to the skill of the participants rather than to any unwillingness to inflict injury. These deer are big, strong, lightning fast, and deadly serious, and that injuries do occur was indicated by several large bucks I saw with wounds and scars. Broken antlers are common. There is no question as to the victor in these fights, and he often chases the loser from the immediate area. Unlike sparring, I saw no serious fights when does were absent from the immediate vicinity.

Sparring and fighting are obviously fundamentally different. It is the youngest males—those lowest in the dominance hierarchy and most unsure of their positions—that spar most frequently. Profiling may allow a buck to assess his opponent's weaponry between rounds of sparring, thereby providing an opportunity to learn his own relative size, strength, and status, and allowing future dominance interactions to be resolved visually, without resort to potentially more damaging forms of aggression. Serious fights, on the other hand, involve big bucks of similar size, occur in the presence of does, and are most frequent during the period of most intense rutting activity. Fights are a dangerous, violent last resort to establish dominance when the reproductive stakes are high.

An interesting contrast to this seasonal pattern of agonistic behavior in bucks has recently been provided by Deborah Koutnick, who studied California mule deer while a graduate student. She reports that does are most aggressive when they are with new fawns in spring and summer and relates this to the does' reproductive strategy. Since most does breed, there is no competition among them for mates, and female agonism during the rut would simply be wasted energy. Their rewards come from bearing healthy offspring, protecting them, and competing for the best resources for their growth. Male aggression, in the fall, is related to competition for breeding opportunities; female aggression, in spring and summer, is related to protection and maintenance of offspring. Both are closely related to reproductive success.

Access to estrous does, and consequent reproductive success, are the ultimate rewards for the winners of male agonistic interactions. To determine the estrous state of a doe, a buck tests her urine. This is done during a highly stereotyped act called flehmen. Immediately after a doe urinates, a buck smells the urine and retracts his upper lip (which exposes the dental pad), extends his muzzle, and turns his head from one side to the other. Scent from the urine can thereby pass to the vomeronasal organ, a structure deep in the nasal area, Len Rue, Jr.

Left: During the rutting period in the fall, the necks of the larger bucks swell noticeably. This is an indication of readiness to breed. Right: The willingness of a doe to stand still determines when copulation takes place. When she is stationary, the buck mounts her by straddling her back with his forelegs. If she is not ready to copulate, she simply starts moving forward.

and the doe's reproductive condition can be determined. Although performed by all size classes of bucks, flehmen was most frequently practiced by the largest males.

When tending a doe, a buck follows her for an extended period, sometimes for a day, sniffing her perineal region and attempting to lick or nuzzle the perineum. The frequency of these acts is correlated with antler class; that is, the biggest bucks are much more involved in tending activities than the smaller ones. The most dominant buck in any group is the only one that tends a doe. No other buck is allowed to show any interest in does, whether in estrus or not, without incurring threats from the dominant buck. The only male–female act consistently ignored by the dominant buck is flehmen.

The timing of copulation is determined by the willingness of the doe to stand for a mount. A doe can prevent unwanted mounts simply by moving. When she is stationary, a buck approaches from the rear and slides his chin along her back or flank preparing to mount. If she remains motionless, the buck straddles the doe's back with his forelegs. If she moves ahead, the buck continues to follow closely. One cannot help getting the impression that much of this attention is annoying to the does, who can rarely get a minute's respite from the advances of their fervent followers.

Copulation follows multiple mounts and involves one thrust. In the four copulations I observed, three of the bucks were of the ten-point class and one was a thirteen-point; all were the most dominant animals present. Following copulation, tending activities toward that doe cease, and the buck turns his attention toward other does or toward maintaining his dominance over other bucks.

The tending buck shows tending behavior toward only one doe at a time and does not attempt to group or herd does or influence the group's direction of travel. Indeed, it was my impression that the direction of travel is determined exclusively by the does. Other bucks are not automatically excluded from the group by the dominant buck; only if they show interest in a doe will the dominant buck pay any attention to them. Thus, despite their sociality, I saw no indication of a tendency by bucks to form or defend harems of does.

Desert mule deer, then, utilize a tending-bond mating system, but one adapted to their group-living existence. The curvilinear relationships found between heterosexual activity and antler class, and the observed mounts and copulations, are quantitative evidence that the biggest, most dominant bucks are disproportionately involved in courting and mating. That harem breeding was not observed does not necessarily invalidate the hypothesis that harem breeding is associated with open habitat. The present study area was far from being totally open; rather, it contained dense thickets, hills, and deeply eroded arroyos, as well as relatively flat, open areas. In much of this terrain, a buck would have little opportunity for easy herding, and it would be difficult to keep rivals away from the harem. Nevertheless, it is reasonable to speculate that the sociality induced by living in an open habitat makes possible the monopolizing of a female group by an individual male. And dense, closed habitats, in which the animals are less gregarious, make the formation of harems much more difficult. ☐

Leonard Lee Rue III

Additional Reading

Amber (p. 26)

As a collector of amber, P.C. Rice had several unfortunate experiences buying amber from reputable dealers. This encouraged her to research the current literature on the subject in depth. The result is *Amber: The Golden Gem of the Ages* (New York: Van Nostrand Reinhold Co., 1980), which she describes as "an attempt to enlighten both the collector and the lapidary in all aspects of the science of amber, including its history, its lore, its nature, its modern sources and its commerce." The book has many photographs, illustrations, and a large bibliography. Less detailed than Rice's book but appropriate for all ages is *The Magic of Amber*, by R. Hunger (Radnor: Chilton Book Co., 1979). For the specialist, S.G. Larsson's paleobiological study, *Baltic Amber* (Klempenborg, Denmark: Scandinavian Science Press, 1978), is a very good technical review. Topics covered include amber and resin, the origin of Baltic amber, and the flora and fauna of amber territory.

Misused Lands (p. 33)

The United Nations sponsored *The World Environment 1972–1982*, a massive, informative study of global environmental trends, edited by M. Holdgate, G. White, and M. Kessas (Dublin: Tycooly International Press, 1982). This official U.N. assessment includes data on population and natural resources. In May 1977, President Carter called for "a one-year study of the probable changes in the world's population, natural resources and environment through the end of the century." Prepared by the Council on Environmental Quality and the Department of State, the three-volume *Global 2000 Report to the President: Entering the Twenty-First Century*, which was completed in 1981, predicts that "if present trends continue, the world in 2000 will be more crowded, more polluted, less stable ecologically, and more vulnerable to disruption than the world we live in now." The study forecasts trends in many areas, including population, income, food, cropland, energy, forests, air quality, and desertification. It is for sale by the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402: $3.50 for volume one (the summary); $13 for volume two (the technical report); and $8 for volume three (which describes the government's global model). An unabridged edition has recently become available from Penguin Books, New York, for $10. *The State of the World's Children* is published annually by the United Nations Children's Fund. The 1981–82 report, written by J.P. Grant, the fund's executive director, reported that seventeen million children died from hunger and disease in 1981 and that the deaths could have been prevented at a cost of under $100 for each child. Copies are available from UNICEF. The World Bank's *World Development Report* appears annually and is the best source of data on world trends, providing statistics on specific countries that deal with the bank. The 1981 report was published by Oxford University Press, New York, and costs $6.95 for a paperback; this year's report is expected out in August. J. Walls's *Land, Man, and Sand* (New York: Macmillan, 1980) is a readable review of the problem of desertification and its solution, deriving its documentation from a U.N. conference on the subject in 1977. T. Clarke's *The Last Caravan* (New York: G.P. Putnam's Sons, 1978) tells the story of how the great Sahel drought, which lasted from 1968 to 1974, affected the Tuareg, a nomadic Nigerian tribe. E. Eckholm's *Losing Ground* (New York: W.W. Norton, 1976) deals with land use and world food prospects and documents the extent of global ecological stress, its political causes and consequences. B. Ward and R. Dubos's *Only One Earth* (New York: W.W. Norton, 1972) is an unofficial report commissioned by the secretary-general of the U.N. Conference on the Human Environment, prepared with the assistance of a large number of consultants from fifty-eight countries. It stresses that humans should accept the "stewardship" of the earth, and is divided into five parts: the planet's unity, the unities of science, the problems of high technology, the developing regions, and a planetary order. *North—South: A Program for Survival*, the report of the Independent Commission on International Development Issues, under the chairmanship of W. Brandt (Cambridge: Massachusetts Institute of Technology Press, 1980), describes trends in world poverty and has proposals for a more workable world order. Cultural Survival and the Anthropology Resource Center publish newsletters and other special publications that deal with the problems of tribal peoples. A one-year's membership to Cultural Survival, 11 Divinity Avenue, Cambridge, MA 02138, includes a subscription to *Quarterly*. Write to them for a complimentary copy, which describes their other publications and projects. Anthropoogy Resource Center's newsletter is published four times a year, costs $6, and addresses current anthropological issues, including problems faced by indigenous peoples. The center is located at 59 Temple Place, Suite 444, Boston, MA 02111. *Economic Development and Tribal Peoples*, an informative, recent public report by the World Bank, is available free from the Office of Environmental Affairs, World Bank, 1818 H Street NW, Washington, D.C. 20433. This 103-page study explains the bank's recently adopted policy of not financing harmful projects in tribal areas.

Mule Deer (p. 50)

Mule and Black-tailed Deer of North America, a Wildlife Management Institute book, compiled and edited by O.C. Wallmo, with illustrations by D.R. Barrick (Lincoln: University of Nebraska Press, 1981), was prepared "to provide a new and formidable base for understanding and managing mule and black-tailed deer and . . . their habitats." It brings together the most pertinent research findings, management experiences, and insights about these animals. Topics covered include deer distribution and habitats; morphological and physiological characteristics; nutrition and metabolism; diseases; behavior and adaptive strategies; population trends, factors, and assessments; different habitats; food habits; and conflicts with civilization. *The Behaviour of Ungulates and Its Relation to Management*, edited by V. Geist and F. Walther (Morges, Switzerland: IUCN New Series Pub. 24, 1974), is a useful 511-page book that deals with a diversity of species, including mule deer. From 1937 to 1950, zoologist J.M. Linsdale and biologist P.Q. Tomich observed and studied the habits of a small number of individual deer and their descendants in a protected reserve in California, seeking to explain the ecology of the mule deer in this area. Their book, *A Herd of Mule Deer* (Berkeley: University of California Press, 1953), covers all aspects of the mule deer's life cycle, including relations to other animals, habitat, activities, food, reproduction, and population. *Natural History*'s last coverage of mule deer was V. Geist's "Downtown Deer," a story about a population of deer in Waterton, Alberta, which appeared in the March 1980 issue, pp. 56–64.

Rita Campon

Reader's Digest
North American Wildlife
An Illustrated Guide to 2,000 Plants and Animals

The sound of the wind in the pines is about the only thing that isn't in it!

Encompassing the total variety of natural communities that make our flora and fauna so splendidly diverse, this extraordinary volume surpasses all the existing guides. Exciting, vibrant new full-color paintings of the 2,000 plus animals and plants point out features critical for identification. Color-coded sections and unique identification charts speed you to the exact pages. Habitat guides reveal the species you're likely to see in a particular environment. It's a book the entire family will enjoy . . . handy enough to serve as a field guide, comprehensive enough for an at-home reference.

Reader's Digest ☆☆☆☆ BOOKS
DISTRIBUTED BY RANDOM HOUSE, INC

¡Speak Spanish like a diplomat!

What sort of people need to learn a foreign language as quickly and effectively as possible? *Foreign service personnel*, that's who. Members of America's diplomatic corps are assigned to U.S. embassies abroad, where they must be able to converse fluently in every situation.

Now you can learn to speak Spanish just as these diplomatic personnel do—with the Foreign Service Institute's Programmatic Spanish Course.

The U.S. Department of State has spent thousands of dollars developing this course. It's by far the most effective way to learn Spanish at your own convenience and at your own pace.

The Programmatic Spanish Course consists of a series of cassettes and accompanying textbook. Simply follow the spoken and written instructions, listening and repeating. By the end of the course, you'll be learning and speaking entirely in Spanish!

This course turns your cassette player into a "teaching machine." With its unique "programmatic" learning method, you set your own pace—testing yourself, correcting errors, reinforcing accurate responses.

AUDIO-FORUM®

This Programmatic Course comes in two volumes. Order one or both.

☐ **Volume I: Basic.** 12 cassettes, (17 hr.), 464-page text, plus manual, $115.

☐ **Volume II: Intermediate.** 8 cassettes, (11½ hr.), 614-page text, plus manual, $98.

(Conn. and N.Y. residents add sales tax)
Shipped in handsome library binders.

TO ORDER, JUST CLIP THIS AD and mail with your name and address, and a check or money order. Or, charge to your credit card (American Express, VISA, MasterCard, Diners Club) by enclosing card number, expiration date, and your signature.

The Foreign Service Institute's Spanish course is unconditionally guaranteed. Try it for three weeks. If you're not convinced it's the fastest, easiest, most painless way to learn Spanish, return it and we'll refund every penny you paid. Order today!

Many other FSI language courses also available. Write us.

Audio-Forum
Suite 520
On the Green,
Guilford, CT. 06437
(203) 453-9794

SPANISH

Or visit our New York sales office: 145 E. 49th St., New York, N.Y. 10017 (212)753-1783

An Ill-timed Modesty

by Matt Cartmill

EVOLUTION: GENESIS AND REVELATIONS, by C. Leon Harris. *State University of New York Press*, $29.50 (hardcover), $9.95 (paper); 339 pp.

> To believe that we know nothing assuredly, and cannot ever know anything assuredly, is to take too much on faith.
>
> James Branch Cabell

A hundred years ago, it seemed obvious to many thoughtful people that the progress of empirical science was bound to usher in a millennial reign of sweet reason, in which we would all have lots of food, few diseases, and little to do but march forward hand in hand into a bright future of accumulated knowledge. Faith in the benign social effects of science got knocked about severely in the First World War and died of radiation poisoning in the Second. The notion that science is even capable of accumulating knowledge is now terminally ill. People who study the history and philosophy of science tell us that science proceeds by an erratic zigzag approach to the truth, and that we can never know whether this year's certainty is just a zig waiting for the next zag. Most historians and philosophers, and quite a few scientists, now consign the dream of accumulating scientific knowledge to a file labeled "Quaint Victorian Delusions," alongside the theories that masturbation causes insanity and the British Colonial Office is an instrument of God's will.

C. Leon Harris's new book on the history of evolutionary thought, *Evolution: Genesis and Revelations*, strives to debunk the illusion of accumulating knowledge. Today's prevailing skepticism about the progress of science takes two chief forms, both of which Harris propounds with gusto. The first is Karl Popper's doctrine that we can never know whether a scientific hypothesis is right, but we can sometimes prove one wrong—which is how we can tell science from nonscience or pseudoscience. The second is to deny that there is any big difference between science and nonscience. In this second view, scientific theories are like art styles: they aren't right or wrong; scientists drop one and take up another for the same reasons of aesthetics and fashion that make painters switch from cubism to surrealism. Of course, these two views are contradictory, which is one of the problems with Harris's book.

The book is a string of nine chapters, representing successive stages in the history of evolutionary ideas: the Bible, the Greeks, the Middle Ages, and so on, down to E. O. Wilson and his Marxist adversaries at Harvard. Each chapter consists of a historical prelude and a philosophical postlude by Harris, draped around a core of excerpts from relevant authors. Some of Harris's comments are perceptive and witty, and some of the excerpts are rare gems that students of evolution will be happy to get their hands on—for instance, a long selection from Patrick Matthew's almost unobtainable 1831 treatise, which anticipated most of Darwin's ideas by a decade. Other excerpts are less well chosen, the worst being a thousand-word extract from a detestable 1946 translation of Lucretius into Olde Iambick Dothish ("For one doth wane/ And, worn with age, doth pine, then somewhat else/ Doth rise to take its place and issue forth/ From whilom place of scorn. . . . ") that must have been picked because its copyright had expired. The unreadable phonebook typeface used for the excerpts will soon have college students (at whom the book seems to be aimed) skipping on to Harris's own breezier, more legible commentaries.

Harris's breeziness obscures the problems that he has with using evolutionary theory as a hanger for a textbook treatment of the history and philosophy of science. This sounds like a good idea, but it really isn't: the clothes keep sliding to the floor. Darwin's theory of evolution by natural selection is arguably one of the three or four most important scientific ideas ever concocted, but that doesn't make it a typical scientific theory or even an exemplary one. Evolutionary theory is peculiar in several ways. Its peculiarities add to its historical and philosophical interest, but they make it hard to use as an illustration of how science works—unless you pretend that they aren't peculiarities or don't exist, which is what Harris is forced to do.

One of the most interesting peculiarities of evolutionary biology is that clergymen keep inciting state legislatures to pass laws against it. The whole notion of evolution is denounced every Sunday from Christian pulpits throughout the United States as a snare and delusion of Satan. Since Satan seldom gets any credit for the theories of relativistic physics or molecular genetics, this hatred of Darwin isn't just part of a general allergy to science. Darwinism must contain some special ideological irritant to evoke such a fierce itching among conservative Protestants. Harris, like any sensible biologist, is dismayed and a bit scared by the current recrudescence of fundamentalist anti-Darwinism, and he opens his mockingly titled book with a saber-swinging charge into the middle of the silly costume-party "creation science" charade. A lot of his blows strike home. If the "creation scientists" were scientists, they wouldn't make Creation Research Society applicants sign a statement testifying to the inerrancy of the Bible; and if they were right about the earth's history, we would expect to find dinosaurs and people fossilized in the same deposits and the world's most diverse faunas in the neighborhood of Mount Ararat. Harris makes these and other good points, but apparently feeling that any stick will do to beat a dog, he descends to specious arguments (for instance, his claim that if the species had been separately created, they would have different genetic codes) and finally stoops to sophomoric ridicule. This is not the way to make converts of those dwelling in darkness. Even atheists of sensitivity will cringe to read some of Harris's jibes at Christian theology, especially his monumentally dumb wisecracks about Aquinas.

There is a good deal of truth in Harris's view of creationism as an anachronism kept alive by willful blindness to evidence. But it's a partial truth and tends to nourish a reciprocally bigoted smugness among scientists. The persistent warfare between science and theology has causes more profound than mere nostalgia. Although it has become an article of the American creed that religion and science can never really conflict—because science asks "how?" and religion asks "why?" or because science deals in facts and religion deals in values, or whatever—this sort of truce can only be maintained by mutual consent or by one of the two allowing itself to be domesticated and confined by the other, with science avoiding certain subjects because they touch on sacred history or religion withdrawing its factual claims about the history and constitution of the universe. To fundamentalists, withdrawing those claims is a sellout ultimately incompatible with Christian belief. The epistemological grounds of fundamentalist hostility to Darwin were eloquently expressed by Walter Lippmann in 1928, in an imaginary dialogue between an evolutionist and a fundamentalist who speaks as follows:

> It would make no difference if the Bible had said that the world was created in seven million years rather than in seven days or that man was descended from an ape. I could believe that as readily as I believe what I now believe. The important question is not what the Bible says about creation, but that the Bible says it.... Doubt is an essential part of the method of science, but it is the negation of faith. To say that you are open-minded about the inspiration of the Bible is nonsense. Open-mindedness in this connection is a perfectly definite rejection of the Bible's inspiration.... Once you submit that authority to the test of human reason you have denied the essence of its authority.... Your request that I should be tolerant and amiable is, therefore, a suggestion that I submit the foundation of my life to the destructive effects of your skepticism, your indifference, and your good nature. You ask me to smile and to commit suicide.

That is a great deal to ask, and we had better learn to appreciate how much it is to ask and to make sure that we have sound reasons for demanding it. The evolutionists' cause is not going to be helped in the long run by self-contradiction. We cannot go on telling the public, as Harris and several other evolutionists have been doing of late, that evolution is a fact rather than a mere theory—and then in the next breath admonish our colleagues and students that science can never hope to attain certainty about anything and that facts don't exist apart from theories anyway. The two claims are not only in conflict; they are probably both wrong.

To say that evolution is a fact may be politic at present, but it seems wrong in several ways, and its wrongness points up some other peculiarities of Darwinism as a scientific theory. Well-constructed theories, basically those in the physical sciences, consist of a mathematical model—a system of equations, for example—and a set of rules for translating the math into real-life terms that can be checked out. If the model yields equations that don't check out when translated, then it's wrong. There are parts of evolutionary biology that come close to this ideal, especially the mathematical theories of population biology and genetics. Some of the predictions of these theories can be checked out, and they tell us a good deal about how evolution can occur and under what circumstances. But they don't say anything about whether all organisms have descended from one or a few ancestral species, which is the supposed fact of evolution. That fact is really a very lofty hypothesis. There are compelling reasons for believing it, but it takes a rather

NATURALIST'S COLOR GUIDE

"This is the book on the subject of color in the natural world that will be the standard now for decades to come...you will wonder how you did without it."
Roger Caras, *CBS Pets and Wildlife*

"A color standard vital for ornithologists."
Books about Birds

"We now have a coding system whereby we can all talk more or less the same language in describing a bird's color."
Bird Banding

This is what the critics are saying about the *Naturalist's Color Guide* by Frank B. Smithe, published by the American Museum of Natural History.

182 colors most often encountered by naturalists and wildlife artists. Each color is deposited in a swatch of non-fading lacquer on heavy cards in a looseleaf field binder. Each color is exact, and was measured spectrophotometrically both before and after deposition.

Includes a book about the colors chosen for the guide and where they may be found in nature. An essential field guide for ornithologists, artists, entomologists, and botanists.

To order, please fill in the coupon below. Members of the Museum may take a 10% discount.

I would like to order______copies of the *Naturalist's Color Guide* at $17.50 each. (Please add $2.50 shipping and handling charge with each order.) Total enclosed: $________

Name

Address

City

State Zip

(Please enclose check with order, and make check payable to the American Museum of Natural History.)

Mail coupon to: Natural History—Publications, 77 West 77th Street, New York, NY 10024. Please allow 6 to 8 weeks for delivery.

thick book to hammer them home. For example, the facts of the fossil record are much better explained by evolution than by any of the alternative theories about the history of living things. Reptiles come before mammals and birds in the sequence of sedimentary rocks, and the oldest mammals and birds are more like reptiles than later mammals and birds are. These facts support the hypothesis of evolution, but only if we make certain assumptions about geology. By the time we have finished marshaling all the evidence that is relevant to the hypothesis of evolution, we have wound up dragging most of modern science into the argument, from quantum mechanics to molecular biology. Calling the resultant edifice a fact is like calling Bach's Mass in B Minor a tune.

Harris properly insists that the overarching "fact" of evolution shouldn't be confused with theories that try to explain how evolution takes place. The best known of those theories is Darwin's theory of natural selection, which is another peculiarity of the Darwinian system. There is a hotly argued but persistent suspicion that the natural selection theory is circular, just adding up to a claim that organisms that have the most offspring are the ones that have the most offspring. Harris goes on at some length about the emptiness of the notion of "survival of the fittest," but never really works up any argument bearing on the crucial question: Is the theory of evolution by natural selection necessarily true (and therefore circular) or does it have implications that we can test—and if so, does it pass those tests? Harris notes certain features of some plants and animals that don't look as though they could have been produced by natural selection, but shrugs them off by saying that Darwin's theory can be saved in these cases if we stick in a few ad hoc assumptions. This is perfectly okay with Harris, because the theory can be made to fit in so many other cases that it's not worth spoiling for the sake of a few counter-examples.

A number of evolutionary biologists have recently begun denouncing this sort of complacency and demanding that the neo-Darwinian theory that has dominated the field since the 1930s be replaced with something else, preferably something that looks more like a nice physical-science theory full of equations and predictions. The trouble is that there isn't much with which to replace natural selection. If the object of evolutionary theory is to explain the diversity of living things, it is stuck with using one or more of the same three basic explanations all theories have to invoke: chance, necessity, or choice. Nobody except the creationists is currently plumping for choice as an explanation of biological facts, and you cannot base predictions on choice without reducing choice to chance or necessity. Most of the current challengers to the neo-Darwinian synthesis opt for injecting a bigger dose of chance into the system. But the system is already riddled with random factors—mutation, drift, founder effect, pleiotropy, fortuitous extinction—and sticking in some more is not going to render our expectations more precise except at the statistical level where big chunks of evolutionary history are involved.

My suspicion is that the whole struggle to make evolutionary biology fit the sort of physical-science model that philosophers of science are comfy with is a mistake. The Darwinian theory can probably be reduced to two basic hypotheses: (1) Most differences between species result, over long periods of time, from differences in the rates of survival for various inheritable differences between individuals in a species; and (2) those differential survival rates aren't entirely random, but are mostly imposed by the environment. Neither hypothesis is circular or vacuous; we can imagine possible worlds in which both would be false. But neither gives rise to many specific expectations about what we are going to find in the living world, and we know of lots of facts that neither hypothesis covers. Both hypotheses are nevertheless almost certainly correct.

The circularity that critics of Darwinism complain about can be seen as the real kernel of Darwin's insight. What Darwin did was to assert that several seemingly separate facts about living things—competition within and between species, the succession of life forms in the fossil record, and the often marvelous adaptation of animals and plants to their peculiar ways of life—are all part of one phenomenon. Each of these facts was well known to biologists of Darwin's day, but each was a separate issue unconnected with the others. To notice that they were connected was like noticing that the morning star and the evening star are both the planet Venus. What looks like a tautology in the notion of survival of the fittest is actually an imaginative equation that is hard for us to see because we are so accustomed to thinking the way Darwin taught us to think. If anything is circular in this equation, it is probably the notion of adaptedness, which continues to give biologists trouble. (Can anyone imagine a world in which animals and plants aren't "built" to live as they in fact live?)

Karl Popper's notion that a proper scientific theory must give rise to expectations that might not work out is important and sound, and Harris is right to push it in the first half of his book. (Darwin's theory passes that test; there are parts of it that are just plain wrong and have had to be junked or revised.) But Popper's notion only makes sense if we agree that the truth or falsity of a scientific theory is something that matters. Oddly enough, Harris devotes much of the last half of his book to denying that and propounding what he calls Harris's Two Laws of Knowledge. The Second Law, "The creativity of a scientist is directly proportional to how much he knows, and inversely proportional to how much he believes," implies that Harris and I ought to be more creative than Aristotle. We aren't. The First Law states, "Belief in the truth of a theory is inversely proportional to the precision of the science." In fact, some of the most imprecise sciences—for example, sociology—are the least concerned about the truth of their theories. Although Harris thinks that well-developed sciences aren't concerned with truth, he seems to expect more from philosophy. "Philosophy," he tells us, "is the only assurance we have that science can provide right answers"; and he assures us that physical-science models of how science works can properly be used to criticize Darwin because "nature did not use one philosophy of science for life and another for the nonliving." Well, no, nature didn't; but then nature doesn't use philosophies of science. People invent them to try to explain how and why science can provide right answers. To date, all that the philosophers have been able to tell us is that science cannot provide any, which is unhelpful and unconvincing.

There is no satisfactory philosophical account of how science accumulates knowledge. Harris, like many scientists who have discovered this, just throws up his hands and denies that knowledge accumulates. He knows better; for example, his Second Law of Knowledge implies that some scientists know more than others. But all he can do in the face of those frowning philosophers is to applaud physicists for their "unconcern with the truth of their theories so long as they [are] useful and interesting." Maybe the physicists are a model for us all. (Politicians certainly find that sort of attitude toward truth effective.) But I tend to suspect that something is wrong here, because occasionally a scientific hypothesis will jump the fence and turn into a cold, hard fact. Let me give an example. In the second century B.C., Erasistratus of Chios taught that the veins in a man's body contain blood, but the arteries contain air. Then why does a cut artery spurt blood in a living man? Because, Erasistratus said, when the air whooshes out it leaves a vacuum that sucks in blood from the veins through capillary vessels too tiny to see. Some 450 years later, Galen's experiments proved that uncut arteries are filled with blood, not air. So he threw out Erasistratus, capillaries and all, and said there were no connections between arteries and veins; each contains a different *kind* of blood, sloshing back and forth from the heart without intermingling. This mistake stuck until 1628, when Harvey was forced to put back Erasistratus' imaginary capillaries to make his theory of blood circulation work. This sorry catalog of errors displays the typical zigzag progress of science, in which the hypothesis we tossed out yesterday may turn out to be tomorrow's best guess. This sort of thing forces us to stay skeptical about what we think we know. And yet, it is clear that Erasistratus and Galen were wrong about circulation and that Harvey was right. Not partly right, not dialectically right, not right until the next theory comes along; just plain old 100 percent correct, then, now, and henceforward. Any surgeon who thinks arteries might contain air after all isn't going to be allowed to operate—not on me, at any rate. The blood really does circulate, and the planets really do go around the sun instead of around the earth, and the earth is roughly spherical and not flat. We know these things—actually know them for certain—and our forebears didn't.

Therefore, knowledge accumulates; and some of that knowledge goes far beyond trivial matters of observable fact. Any account of science that pretends we don't know that blood circulates is simply being falsely modest. When science and its assumptions are being fiercely attacked by intelligent, well-organized people who claim to have better sources of knowledge, the false modesty we have picked up from the philosophers may prove suicidal. Fundamentalists read Karl Popper, too.

Matt Cartmill is professor of anatomy and associate professor of anthropology at Duke University.

End the Pain and Misery of Tired Aching Feet

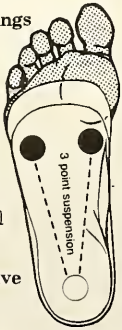
No matter how long you've suffered — be it three months, or 30 years. No matter what your problems are—corns, calluses, pain in the balls of your feet, burning nerve endings, painful ankles, old injuries, backaches, or just plain sore aching feet.

When you slip a pair of Feathersprings® into your shoes your pain will vanish almost instantly. You'll be able to stand, walk, dance, even run in miraculous total comfort!

What are Feathersprings?
Well, they're a revolutionary foot support unlike anything you've ever seen before. Each pair is custom hand-formed and made for your feet alone.

How do Feathersprings work?
Unlike conventional, mass-produced devices, they actually imitate the youthful, elastic support Nature intends your feet to have.

What do Feathersprings look like?
They're all but invisible. Men and women can even wear them with open-backed sandals. And because you can change them from one pair of shoes to another, one pair is all you'll ever need.



How many people have Feathersprings actually helped?
As of today, over 2,250,000 people of all ages with all types of foot, leg and back problems, are enjoying blessed relief they never thought possible.

How do I know Feathersprings will help me?
We are so certain that Featherspring Foot Supports will bring you relief with every step you take, that if they don't work for you ... we'll refund your money in full with no questions asked.

Feathersprings cradle your foot

Don't needlessly suffer pain and discomfort for another day. If your feet are killing you, Feathersprings will bring you relief. Write us for more detailed information. There is no obligation. No salesman will call. Just fill out and mail this coupon. Remember, you have nothing to lose but your pain.

What people have to say about Feathersprings ...

"Received my wife's Feathersprings two days ago. They are super-neither of us can believe the results. She has had terrible feet for years; already no pain. Incidentally, her sore knee is better ... As a retired physician, this result is amazing."
Dr. C.O.C.,
Tucson, Arizona

*

"I was extremely skeptical when I placed my order, and was expecting to be disappointed. Much to my surprise, I found almost immediate relief from knee and leg pains and corns on my right foot which were a source of continuing pain and irritation have ceased to trouble me."
J.C.J. Meridian, Miss.

*

... *"At the present time I still wear the Feathersprings and indeed they perform well after* seven *years of use."*
G.M.G., Dallas, Texas

*Posed by professional models.
© 1982 Featherspring International Corp.
13100 Stone Avenue, North, Seattle, Washington 98133

FEATHERSPRING INTERNATIONAL CORPORATION
13100 Stone Avenue North, Dept. NHO62
Seattle, Washington 98133

YES! I want to learn more about Flexible Featherspring Foot Supports. Please send me your free brochure. I will watch for the large PINK envelope. I understand that there is no obligation and that no salesman will call.

Print Name

Address

City State Zip

When in Seattle visit the Featherspring Building.

Share the Thrills of Exploring Outer Space!

$359.95 f.o.b. Hartford, Conn.

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

Criterion Manufacturing Co.
620 Oakwood Ave., W. Hartford, Conn. 06110

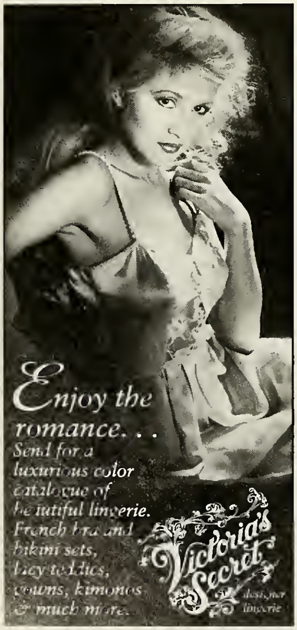
® TM Registered U.S. Pat. Office

CRITERION, MANUFACTURING CO., Dept. NH-115
620 Oakwood Avenue, W. Hartford, Conn. 06110
Please send your free Telescope Guide.

Name____________________

Address____________________

City________________ State________


Enjoy the romance. . .
Send for a luxurious color catalogue of beautiful lingerie.
French bra and bikini sets, teddies, gowns, kimonos & much more.
Victoria's Secret
designer lingerie

Send $3 to Victoria's Secret, Dept. NH-06
Box 31442, San Francisco, CA 94131
Boutiques in San Francisco, Palo Alto & Cupertino, CA

The Impossible Star

The brightest object in a cloud of gas and dust in a neighboring galaxy is confounding the experts

by Stephen P. Maran

A mysterious glowing object 180,000 light-years from the earth is the subject of intense interest among astronomers. Observers in South America and Australia are focusing telescopes on R136a, as the object is called, and a NASA satellite has repeatedly measured its ultraviolet light. At conferences, experts debate the nature of R136a, still unsure whether it is a single, brilliant star or an unusual, closely packed star cluster.

If R136a is a single star, it is by far the most massive star known. In that case, according to calculations made by astronomers at the University of Wisconsin, Madison, and at the Joint Institute for Laboratory Astrophysics in Boulder, Colorado, R136a has about 3,000 times the mass of the sun, is ten times hotter than the sun, and eighty times larger in diameter. If the calculations are correct, then R136a is breaking the rules, since astrophysical theory says that stars larger than about 150 times the mass of the sun cannot form. Indeed, with the possible exception of R136a, no such stars have ever been found.

R136a is located in the Large Magellanic Cloud, a neighboring galaxy of our own Milky Way. More specifically, the brilliant object lies within the remarkable Tarantula nebula, also called 30 Doradus. Of this nebula, it once was written that, if moved to the location of the familiar, much closer, Orion nebula, 30 Doradus "would fill the whole constellation of Orion, and the radiation from it and its involved supergiant stars would be strong enough to cast easily visible shadows on the earth." These words, penned by the famous Harvard astronomer Harlow Shapley, are not far off the mark although we now know that Shapley underestimated the distances of both 30 Doradus and the Orion nebula.

Since Shapley wrote on the subject in the early 1940s, many astronomers have investigated 30 Doradus. They have mapped the nebula, listed its contents, and measured its brightness, spectrum, gas motions, and other properties. Among the contents is a cluster of bright, hot, young stars. At the heart of the cluster, a nebulous clump was cataloged, as if it were a star, under the designation R136. Even during the 1950s, however, some observers believed that R136 consisted of more than one star, although they had no proof.

In 1953, an astronomer in Pretoria, South Africa, photographed the spectrum of R136 with the 74-inch telescope of the Radcliffe Observatory. (Incidentally, the "R" in R136 stands for "Radcliffe.") This observation revealed that the spectrum of the clump was much brighter at blue wavelengths of light (indicating high temperature) than the spectrum of any young star in the files of the observatory.

An additional spectrum was obtained in December 1972 at the Las Campanas Observatory in Chile by Nolan R. Walborn, a visiting astronomer from the University of Toronto. Walborn noted a close resemblance between this spectrum of the R136 clump and the spectrum of HD 97950. The latter object is at the center of NGC 3603, a large, bright nebula in the Milky Way that is about 27,000 light-years from the earth and thus is almost seven times closer than R136. Although HD 97950 was cataloged as a single star, photographs made by Walborn at the observatory in Chile showed that it actually consisted of a group of at least six closely spaced stars.

Because R136 and HD 97950 have similar spectra and each is the brightest object in a large bright nebula, Walborn proposed that they are similar objects. At the great distance of R136, a compact group of stars such as HD 97950 could not be distinguished as separate stars. Instead, Walborn thought, the group would appear as a clump, as R136 does. Thus, he concluded that R136 may also be composed of a small group of stars.

Dutch astronomers, Fjeda and Jo Walraven, a veteran husband-and-wife team, gathered evidence suggesting that the putative star group might be even larger than Walborn suspected. With a telescope at the Leiden Observatory's Southern Station in the Transvaal, they measured the brightnesses of R136 and hundreds of other objects in the Large and Small Magellanic Cloud galaxies. The objects included stars classified as among the most luminous and massive stars allowed by theory. Yet the Walravens found that R136 was much brighter than any of these. At a January 1975 conference on the Cape of Good Hope, they accounted for the great brightness of R136 by suggesting that it might be a star cluster, with "about 60 members very closely packed." In this view, R136 is a densely populated cluster, less than three light-years in diame-

GET AWAY TO PARADISE!
CRUISE TAHITI!
AND FRENCH POLYNESIA

NOW'S THE TIME TO PLAN YOUR FALL/WINTER VACATION

DEPART PAPEETE 4 TO 9 NIGHTS FROM $749

All new Itinerary! Discover for yourself the incredible beauty of the Society Islands on this newest Exploration adventure! Embark at Papeete, Tahiti, the French Polynesian Gateway, to cruise within the aquamarine lagoons of these spectacular tropical islands. Enjoy fascinating shore excursions to discover the colorful villages and resorts on **Bora Bora, Huahine, Raiatea, Tahaa** and **Moorea,** plus unparalleled snorkeling and beachcombing.

Relax aboard the full-service **Majestic Explorer,** our brand new Explorer Class™ cruise ship featuring 44 bright, air conditioned outside staterooms, each with private facilities and two lower berths or double bed. There's a large, picture-windowed dining room that serves sumptuous meals, plus a lounge with bar and spacious sundecks.

The ship is your hotel throughout the cruise; no baggage drills to interrupt the relaxed pace. Varied ship programs and shore excursions allow explorers of all ages to fully enjoy a relaxing, unique experience. To expand your Polynesian Adventure, choose from our extended-stay CruiseTour programs or optional resort hotel extensions.

Fly to Tahiti via UTA French Airlines at special low air fares, available with our cruise!

It's the cruise opportunity of a lifetime, available nowhere else! For best selection of dates and stateroom, plan your Getaway to Paradise now; for a free color brochure, see your travel agent or call toll-free:

800-426-0600
(in Washington State call 206/624-8551).

EXPLORATION CRUISE LINES™
1500 Metropolitan Park Bldg., Dept. NH-TC6, Seattle, Washington 98101

UTA
French Airlines

Please send me a free copy of your new Tahiti Cruise Brochure.

NAME
ADDRESS
CITY STATE ZIP

A Division of Alaska Tour and Marketing Services, Inc.

Now available with optional wooden floorboards!
Our SEA EAGLE 8
• 9'7" x 4'6"
• Holds 4 adults
• 3 hp capacity
• Weighs 31 lbs
• Costs just $220

The Quality Alternative to High-Cost Inflatable Boats!

Why pay $600, $1000 or more for an inflatable boat?

Modern technology and improved materials make possible inexpensive and long-lasting inflatable boats. Prices start at just $110.

For lakes, rivers, ponds, bays and even ocean surf.

Fishing, camping, river-running, yacht tending . . . Sea Eagles give you more fun for your money.

Canoes, dinghies and motor-mount boats.

● Write for FREE brochure.

☐ **Please rush me FREE brochure**

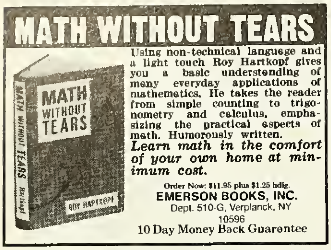
name
address
city
state zip

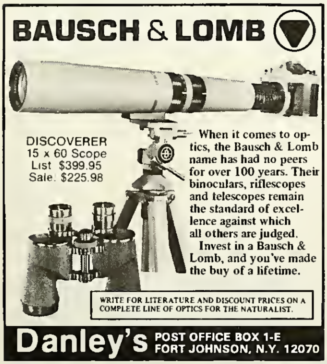
Sea Eagle, St. James, NY 11780
NH6B

SEA EAGLE®

Or phone 516-724-8900, Mon-Fri, 8:30am-4:30pm EST

BOOK HUNTING?
Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: BOOKS-ON-FILE
Box 195 Dept. 72
UNION CITY, NEW JERSEY 07087


MATH WITHOUT TEARS
Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written.
Learn math in the comfort of your own home at minimum cost.
Order Now: $11.95 plus $1.25 hdlg.
EMERSON BOOKS, INC.
Dept. 510-G, Verplanck, NY
10596
10 Day Money Back Guarantee


BAUSCH & LOMB
DISCOVERER
15 x 60 Scope
List $399.95
Sale: $225.98
When it comes to optics, the Bausch & Lomb name has had no peers for over 100 years. Their binoculars, riflescopes and telescopes remain the standard of excellence against which all others are judged. Invest in a Bausch & Lomb, and you've made the buy of a lifetime.
WRITE FOR LITERATURE AND DISCOUNT PRICES ON A COMPLETE LINE OF OPTICS FOR THE NATURALIST.
Danley's POST OFFICE BOX 1-E
FORT JOHNSON, N.Y. 12070

Treasures From The Earth
Color Portfolio of Natural Specimens and Catalog of Minerals, Display Stands, Books and Natural Jewelry, $3.00
Dover Scientific
Box 6011C Long Island City, NY 11106

Adirondack Mts.
rustic hamlets
The beautiful Adirondack Mts located within six million acres of sparkling lakes and unspoiled wilderness—
—Just off the beaten path —
Send for our color brochure
Essex County Tourism Dept NH
Elizabethtown, NY 12932
Essex County
Olympic County, N.Y.

ter, at the heart of the larger and sparser star cluster in the Tarantula nebula.

Meanwhile, the August 1974 launch of a Dutch satellite called ANS (Astronomy Netherlands Satellite) gave astronomers a new tool with which to study stars and nebulae. The tool was a small telescope, just under nine inches in diameter, equipped with photoelectric detectors to measure ultraviolet light. Despite its small size, the ANS telescope accomplished many significant observations. Used to map the ultraviolet light of the Tarantula nebula, the telescope revealed that the light does not arise uniformly over the area of the nebula, but is brightest in a small concentration, sixteen light-years in diameter, centered on R136. The measured intensity showed that the total luminosity of the stars in the nebula exceeds that of our sun by a factor of about 100 million, with much of this light coming from the R136 clump itself. The suggestions by Walborn and the Walravens that the clump is composed of a small group or even a cluster of sixty stars remained to be proved.

A key observation was reported in April 1980 by a team of astronomers under Johannes Feitzinger, an investigator of galaxies and nebulae at the Astronomical Institute in Bochum, West Germany. The West German team identified three separate smaller condensations in what previously had been recorded as a single clump. This breakthrough was accomplished with a series of photographs taken during 1976 and 1977 with the 141-inch telescope of the European Southern Observatory on Cerro La Silla, Chile, and with a smaller telescope. The astronomers at Bochum analyzed the photographs with computer techniques that enhanced the contrast and brought out fine details. This revealed the three condensations within R136, which they named R136a, R136b, and R136c. Thanks to photographs taken through filters of various colors, it became clear that R136a is both the brightest of the three condensations and the bluest. The color is important because the bluer that stars are, the hotter they are. Although the West Germans concluded that at least sixteen stars are responsible for heating the Tarantula nebula, they found that R136a is the primary energy source, outshining all of the other stars in the nebula. They suggested that R136a is a star with an unprecedented mass of 250 to 1,000 times that of the sun and a temperature of about 90,000° to 99,000° F. If so massive a star actually exists, it would generate a powerful stellar wind of hot gas, streaming away in all directions. The West Germans noted that such a wind would affect the structure of the surrounding nebula.

At this point, it is worth considering why, supposedly, supermassive stars do not form. Cynics might say (indeed, some do) that the theories predicting that stars heavier than about 150 solar masses cannot form were devised by theorists who already knew that the most massive known stars are in that approximate range. A generation ago, astronomers thought that few if any stars were heavier than about sixty solar masses, and one theory at the time accounted for this circumstance by a calculation that suggested that the heavier stars would pulsate violently and shake themselves apart.

Subsequent analysis showed that the pulsations of massive stars are not as violent as had been thought, so that stars can form with masses more than sixty times that of the sun. The more recently proposed "limit" of about 150 solar masses is instead ascribed to the force of light that supposedly pushes away matter as a star in the making attains great mass. When a massive star forms by the falling together of matter from a cloud of gas and mineral particles (the latter are called "dust" by astronomers), it begins to generate light in its central core even as more gas and dust accumulate at its periphery. According to one theory, the light becomes intense enough to blow away the surrounding material and thus the star can gain no more mass. Another theory postulates the existence of a shock front in the infalling matter. Gas passing through the shock front is heated and glows sufficiently brightly, it is claimed, so that it pushes away the dust in the surrounding cloud. (This process resembles the motion of dust in a comet tail, where the pressure of sunlight drives the dust away in the direction opposite the sun.) The dust drags the adjacent gas outward and hence no more matter can accumulate in the newborn star. All of the above, I hasten to add, is theory that is not well grounded in hard facts, since no one has observed the formation of a star. Further, the theories involve simplifications that may not be valid in the actual circumstances of the birth of a star.

Renewed interest in the possibility that R136a is a supermassive star came recently after it was studied with the International Ultraviolet Explorer (IUE). The IUE is an orbiting observatory, launched by NASA in January 1978, that is furnished with a telescope twice as large as that in the ANS. Further, the IUE telescope is equipped with instruments to record the ultraviolet spectra of its celestial targets, and not just measure the brightness of their light (see "Telescope in Space," *Natural History*, July 1980). From spectra, we can determine physical parameters of stars and nebulae, such as their temperature, chemical constituents, and velocity toward or away from the earth.

Seven observations of R136a were made with the IUE from 1978 to 1980. Analysis of these ultraviolet spectrograms by Joseph Cassinelli, John Mathis, and Blair Savage, all astrophysicists at the University of Wisconsin, indicated that if R136a is indeed a single star, it must be even hotter and more massive than the West German astronomers had suspected. The spectrograms revealed that there is indeed a rapid and powerful stellar wind, as the West Germans predicted. The Wisconsin team estimated that R136a has 2,500 times the mass of the sun and a temperature of about 110,000° F. They gauged its wind speed at almost 8 million miles per hour and calculated that the wind is carrying off gas from the great star at a rate of one solar mass every 3,200 years. An Australian radiotelescope had earlier provided measurements of the total energy that keeps the Tarantula nebula shining so brightly. Cassinelli, Mathis, and Savage concluded that most of this energy comes from R136a.

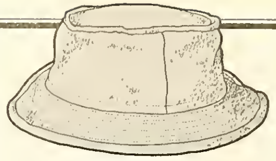
Despite much excitement about the putative "supermassive star," the possibility remains that R136a is a cluster of hot young stars, packed too close together to be individually distinguished by present techniques. According to the Wisconsin astrophysicists, the cluster would have to contain thirty stars of the most massive known type, all within one-third of a light-year of one another. Thus the cluster would be ten times smaller than suggested by the Walravens. But such stars are rare and no cluster is known in which dozens of them are present and packed tightly together. Even if there were such a cluster, it might not be capable of producing all of the details that have been found in the ultraviolet spectrograms of R136a.

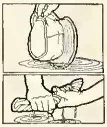
In April 1981, high-quality visible-light spectrograms of R136a were obtained with the 158-inch telescope at Cerro Tololo Inter-American Observatory in Chile by Peter Conti. Conti, an expert on massive stars at the Joint Institute for Laboratory Astrophysics in Boulder, Colorado, analyzed the spectrograms together with Dennis Ebbets, a young spectroscopist from the University of Wisconsin. Early this year, I heard Ebbets report the results to a large throng of astronomers at a conference in Boulder. The analysis generally supports the conclusions of the IUE observers. In particular, many significant details of the visible-light spectrograms can be accounted for by the existence of a 3,000-solar-mass star. Also in the audience was Walborn, who recently began an extended stay at Goddard Space Flight Center in Greenbelt, Maryland, where I work. He still maintains that R136a is a star cluster, and vociferously criticized the supermassive star concept at the conference.

There does seem to be a way in which the spectroscopic evidence of the Wisconsin and Boulder investigators can be reconciled with the presence of a compact star cluster rather than a supermassive star. Ebbets and Conti point out that if the star cluster contained several dozen massive stars of two different known types, the spectral details might be accounted for in part by the combined light of stars of one type and in part by stars of the other type. Then there would be no need to postulate the existence of a star that, theory says, cannot be. Astronomers would be left, however, with the hypothesis that R136a is a star cluster as remarkable and different from any previously known as one could imagine. At present, no one knows how such a cluster might have formed.

In my view, the supermassive star interpretation of R136a is based on straightforward physical reasoning from the observed spectra. The strongest point of the star cluster advocates is that one ought not to postulate a star twenty times more massive than any other known star when the observations can be accounted for in terms of stars (albeit, many of them) of known types. This is an argument of philosophy, not astrophysics, and it may or may not be right. The cluster interpretation of R136a invokes the existence of a star group that many of us would find as amazing as a 3,000-solar-mass star. If I had to place my bet, I'd go for the supermassive star. But it would have to be a very small stake.

Stephen P. Maran is a senior staff scientist in the Laboratory for Astronomy and Solar Physics at NASA's Goddard Space Flight Center in Greenbelt, Maryland.





KEEP A COOL HEAD

100% cotton terry cloth beats summer heat 2 ways: Use it to wipe your perspiring brow or douse it in water, wring it out and wear to keep cool while vacationing or playing sports. **Colors:** Navy Blue, Powder Blue, White, Yellow. **Sizes:** S(6¾-6⅞), M(7-7⅛), L(7¼-7⅜), XL(7½-7⅝), XXL(7¾-7⅞). **$7.75 ppd.**

Order Today! Money Back Guarantee!

Here is my check or money order for $______
(Add sales tax for shipment into CA, CO, D.C., IL, MA, MI, MN, PA, WA).

RUSH my **#2002 Terry Cloth Toweling Hat.**

Color ______ Size______
Name ______
Address ______
City ______
State ______ Zip ______

☐ Send me your FREE outdoor catalog.

Eddie Bauer®

Dept. ANH, Fifth & Union, Seattle, WA 98124

EXPLORE PAPUA NEW GUINEA aboard the M.V. Melanesian Explorer

Join a small group of discerning passengers aboard the fully air-conditioned Melanesian Explorer.

Visit the Sepik River plus islands and areas never before seen by tourists.

Operates year round on segments ranging from 4 to 16 days. For full details write or call:

Melanesian Tourist Services
P.O. Box 707, Madang, PNG
Tlx: NE 82707 Tel: 822766
or,
UNIREP
Suite 105, 850 Colorado Blvd.,
Los Angeles, Ca 90041
Tlx: 4720179 Tel: (213) 256-1991

Melanesian Tourist Services

For bookings or additional information, please contact your travel agent or send this coupon to Melanesian Tourist Services's North American Representative, Unirep.

NAME ______
STREET ______
CITY/STATE/ZIP ______
PHONE ( ) ______

THE MARKET

Art

AA TO ZZ, Animals—Nature—People on Rubber Stamps. Beautiful designs, catalogue $1.00. Tuckers-NH2, Box 849, Pulaski, Virginia 24301

AMERICAN INDIAN CRAFTS: Southwest Indian pottery, baskets, rugs, kachinas. Northwest Coast Indian masks, totems, graphics. Eskimo sculpture. No catalog. One-of-a-kind pieces, individually photographed. Priced $100/up. Photos and data available. Specify interests. Box 5896. Sherman Oaks, CA 91413. (213) 789-2559

AUDUBON PRINTS, Original handcolored birds and animals. Write Audubon, 9720 Spring Ridge Lane, Vienna, VA 22180

Pre-Columbian Collectibles!

PARADISE OF TLALOC (200 B.C.-A.D. 900), the Mexican rain God of the Aztecs—only one of many original serigraphs and rubbings of Aztec and Maya ruins! Complete color catalog $2 (deductible with order).

BERNARDO
2400 Westheimer Suite 108W (NH3)
Houston, TX 77098

"TERRIBLE LIZARDS" beautiful lifelike replicas of dinosaurs, iguanas, etc. Artistic Dinosaur Company. Rt. 32, Uncasville, CT (203) 848-0616

YANG JOO MASK, Korea, painted wood, cloth hood, $95, request photo, McCoy Imports, Liberty, NY 12754

Back Numbers

NATIONAL GEOGRAPHICS 1888-1982, issues Book Publications, Collectors Items, Send Wants Buxbaum Geographics, Box 465-NH, Wilmington DE 19899

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHR, 84 Fifth Avenue, New York, NY 10011

Books

BOOKFINDING. Librarians search worldwide titles or subjects plus 150,000 indexed stock. PAB, 2918 Atlantic, Atlantic City, NJ 08401 (609) 344-1943

ORNITHOLOGICAL books, scarce, out of print, rare. Natural history color plate. Catalogues $2.00. Book Chest, 19N Oxford Place, Rockville Centre, NY 11570

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalogue: Hamilton's, 98-55 Clapboard, Danbury, CT 06810

TRAVEL, ADVENTURE, AND EXPLORATION Books. The usual and the unusual. Free catalogue from The Armchair Explorer, Dept. NH, 333 Bellam Blvd , San Rafael, CA 94901

YESTERDAY'S BOOKS LOCATED, no obligation. Out-of-State Book Service, Box 3253J, San Clemente, CA 92672 (714) 492-2976

Correspondence

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin, West Germany

PENFRIENDS-ENGLAND-USA. Make lasting friendships through correspondence. Send age, interests. Free reply. Harmony, Box 89NH, Brooklyn, NY 11235

SINGLE BOOKLOVERS gets cultured persons acquainted. Nationwide. Established 1970. Write Box AE, Swarthmore, PA 19081 or call 215-566-2132

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest handbook, $2.00 (guaranteed). Australian International Services, Box 19107-RS, Washington, DC 20036

AUSTRALIA—NEW ZEALAND—THE WORLD! 50,000 Jobs! Big pay. All occupations. Transportation. Tax free. Computerizerd reports $2.00. Jobworld, Box 681-NH, Cypress, CA 90630.

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RS, Washington, DC 20036

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . . Intermountain 4Y, 3506 Birch, Cheyenne, WY 82001

TEACH HERE—TEACH ABROAD: School, College openings: USA $5.95; Abroad $5.95. Placement sources: USA $4.95; Abroad $4.95. EISF, Box 662, Newton, Massachusetts 02162

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Kenya. Sampler: 4/$2.98. Free Brochure. Multinewspapers, Box DE-206, Dana Point, California 92629

Gourmet Interests

COLORFUL, ILLUSTRATED BOOKLET; 6-menus & recipes for home entertaining; $3; SASE; Underground Hostess, P.O. Box 92, Cherry Plain, NY 12040

SHIITAKE, OYSTER MUSHROOM MINI-FARMS. Exotic delicacies grow in your own kitchen, just open the bag and watch. Simple instructions included. Shiitake $10.00 west of Rockies, $17.00 airfreighted east. Tree-oysters $8.00 west, $15.00 east. Sample instructions $1.50 each. Far West Fungi, Box 763, Watsonville, CA 95077

Government Surplus

GOVERNMENT SURPLUS! Millions of items (Including Jeeps) . . low as 1¢ on dollar! Most complete Directory available—$2.00. Disposal, Box 19107-RS, Washington, DC 20036

JEEPS, CARS, pickups from $35. Available at local Government Auctions. For Directory call (805) 687-6000 Extension 910. Call refundable

Merchandise/Gifts

BLANK VOLUMES HANDMADE with leather bindings. For information Write: Bob Giordano, 46 Kelly Parkway, Bayonne, NJ 07002

HIGH QUALITY, handmade, unique decorative items. Send $1.00 to Unlimited Special Effects, Inc. 3807 N. Lincoln, Chicago, IL 60613 for brochure

KITS! Build your own dulcimer, mandolin, even harps, lutes, and harpsichords. Free catalogue. Hughes, 4419 West Colfax NH, Denver, CO 80204

MAKE YOUR COUCH A WALDEN'S POND with these lovely Needlepoint Designs of Frogs and Friends. $2.00. L. Mayo, 57 Rock Spring Road, Apt. 20, Stamford, CT 06906

PEWTER SEASHELL BOXES! Original designs—museum quality—affordable prices. Free catalogue for collectors. Write "Yorkshire Country Collectibles", N11, 3080D West Tharpe, Tallahassee, Florida 32303

STAR-FARING WINGS! Leading design attraction. Color proof–$2.00 (refundable). Windshield decal–$7.00. Wonderwave, Box 219-N, Malverne, NY 11565

UNSURPASSED AQUARIUM FISH mailed. Filters. Plants. -25%. Catalogue 50¢ (Refundable). (313) 627-2877. Aquadiscount, 33561 Mill, Ortonville, MI 48462

Miscellaneous

HAVE YOUR PLANTS IDENTIFIED. Professional botanists will try to identify any plant. Send well dried material, preferably pressed. Include leaves, stem and flowers or fruits. Enclose $7.50 per identification. Cornell Plant Identification Service, P.O. Box 2652A, Ithaca, NY 14850

INTEGRATE THE BEST OF URBAN AND RURAL LIFESTYLES with progressive political and social values in one of five established rural communities. Nonsexist, non-racist, gentle cultures based on cooperation, equality, and environmental concern. For free information ($3.00 donation appreciated) write: Federation of Egalitarian Communities, Box E-NH 62, Tecumseh, MO 65760.

Optical

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON. Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired. Large stock. Orders filled postpaid day received. Birding, Box 5N, Amsterdam, NY 12010

OPTIC DISCOUNTS: Binoculars—Telescopes—Brand Names. Free List. Thos. Manetta, Box 12, 61 Hoffman Ave., Elmont, NY 11003

Personals

MEET SINGLES Mexico, Orient, Europe, Australia. Free information. Write: International, Box 1716-NH, Chula Vista, CA 92012

Poetry

"FOR LOVERS" the most intimate book of poems ever written for those in love and those alone. For your copy send $10.00 + $1.50 shipping to Vanstead, Box 382 Dept N, Freehold, NJ 07728

"THE SWIFT & THE HUNT", poetry and art by Jo Ann Taylor, Box 483, Carrizo Springs, Texas 78834. Postpaid $6.00

Post Cards

NATURE POST CARDS—Close-up color photos of birds and animals. Beautiful & educational. $8.97 for 111, all different. Birds, Animals, plus all our other Nature Cards, 176 cards for $12.00. (Not retailed to Illinois addresses. Wholesale rates available all states.) Nature Press, 628 E. 20th St., Alton, IL 62002

Real Estate

FREE. BIG SUMMER CATALOG! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Recreation, Retirement buys! Selected best throughout the U.S. Over 700 offices, 43 states all across America! Yours free from the world's largest! Strout Realty, Inc., Executive Park Tower, Dept. 5390, Albany, NY 12203. Call toll free 1-800-641-4266

FREE CATALOG. Describes and pictures farms, ranches, acreages, businesses and town and country homes from coast to coast. UNITED FARM AGENCY, INC., 612-U W. 47th St., Kansas City MO 64112. Call Toll-Free: 1-800-821-2599; MO res. call Toll-Free: 1-800-892-5785

COSTA RICA: SMALL, SUCCESSFUL modern country Hotel. View of the Pacific. On a 12 acre wooded farm near the Monteverde Cloud Forest. Costa Rican part owner willing to retain part interest and active role. Write: Hollander, APDO 10165 San Jose, Costa Rica

GOVERNMENT LANDS . . . FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00. Lands, Box 19107-RS, Washington, DC 20036

101 ACRE PARCEL, 10 acre wooded building lots, off State road, Gore Mt. ski area, summer fun, hunting, loafing. Take home fireplace wood. Low taxes. O. Stromberg, N. Creek, NY 12853

Recordings

OLD TIME RADIO PROGRAMS on cassette tapes. Free catalogue. Cassette Library Center, P.O. Box 5331H, Baltimore, MD 21209

Rentals

BIRDING-SHELLING: Sanibel Island, Florida. Two-bedroom condominium on Gulf; completely equipped. Bargain Vacation. Willson, 119 Dixboro, Ann Arbor, Michigan 48105

FRIPP ISLAND, S.C. Luxurious ocean front condominium, 3½ miles unspoiled beach. One bedroom, tastefully furnished, modern kitchen, dining, living, sleeps four. Golf, tennis, wildlife sanctuary, near historic Beaufort & Savannah. (201) 545-1256

HEAVEN: modern, secluded lakeside log home $260.00; wilderness cabin, $87.00 weekly. Santa Lake, Temple, Maine 04984

Resorts

ADIRONDACK LODGES on Upper Saranac Lake. Available for two weeks or a month, July through September. Everything provided for comfortable living in the quiet woods. $650-$1,700 for two weeks. Please write Bartlett Carry Club, RFD 3, Tupper Lake, NY 12986

ADIRONDACK PARK, Paradox Lake, 3-bedroom cottages, screened porch, fireplace, tennis, boating, Informal, wk/mo/season (212) 339-1705

ADIRONDACK WILDERNESS, sparkling mountain lake, informal, great tennis, food, hiking, horses; family rates. American Plan. Timberlock, Box NH, Indian Lake, NY 12864

LINEKIN BAY SAILING RESORT. Fleet of sailboats, sailing instruction, two-masted schooner, heated pool, tennis. Write for folder Boothbay Harbor, ME 04538

NEW MEXICO—Cabins on mountain stream—Fishing—Sightseeing—Horseracing—Art & Music festivals. Ruidoso Lodge, Box 2316, Ruidoso, NM 88345. (505) 257-2510. Open year round.

TOBAGO, PRIVATE BEACH COTTAGES on working cocoa plantation. Swimming, snorkeling, fishing from your front door. Bird watcher's paradise. Brochure. Charles A. Turpin, Charlotteville, Tobago, West Indies

Schools

FIELD COURSES IN NATURAL HISTORY. College credit, Write Aspen Center for Environmental Studies, Box 8777A, Aspen, CO 81612

FREE—PARENTS GUIDE. Over 400 private resident camps, summer programs and schools in U.S. and abroad, serving children 6-16. Most visited by publisher. For guide and free referrals give child's age, grade, interests, geographical preference and entrance date. Established 1940. Vincent/Curtis Rm. 216, 224 Clarendon St. Boston, MA 02116

Tours/Trips

AFFORDABLE INDIVIDUALITY: Legendary Cultures, Fascinating Nature. 192 Uncommon tours to Latin America, Africa, Europe and Asia. For demanding individuals or small groups. Fully assisted, skilled guides/escorts where needed. Forum Travel International, 2437 Durant, Berkeley, California 94704. (415) 843-8294

AUDUBON'S WESTERN EDUCATION CENTER and Point Reyes Bird Observatory offer birding and natural history excursions of educational depth and conservation emphasis to Arizona, Alaska, Condor country, Hawaii, Mexico . . . For brochure: Natural Excursions, 4990 Shoreline, Stinson Beach, CA 94970 (415) 868-1221

AFRICAN WILDLIFE & CULTURES: Botswana, Madagascar, Namibia, Rwanda, South Africa, Tanzania. "Evolutionary Safaris". Forum Travel, 2437 Durant, Berkeley, California 94704 (415) 843-8294

BICYCLING TOURS IN FRANCE, Sept. & Oct. '82. Two unusual private two-week cycling tours, Chateaux of the Loire & Brittanny in Sept.; Dordogne Valley in Oct. For only 10 to 15 adults who enjoy exercise plus hotel amenities & fine food. Details write: Nan Rheault, R.F.D. Vineyard Haven, MA 02568

DISCOVER BAJA! Join experienced naturalists and crew for leisurely ocean-going explorations of the wilderness islands and lagoons of Baja's Pacific coast, the Sea of Cortez, or Mexico's tropical west coast. Enjoy whales, seals, dolphin, birding, fishing, nature study, island hiking, and more! Excellent photo opportunities. Small groups,relaxed pace. Trips 4-10 days year-round for individuals or groups. Color brochure: Pacific Adventures Charter Service, 2445 Morena Blvd., Suite 200H, San Diego, CA 92110 (714) 275-4253

EXPLORE THE SEA OF CORTEZ with Scripps Aquarium Oct. 17-23, 1982. Dive and collect Mexican marine life for exhibits and research. Scuba certificates required for divers. Scripps Aquarium-Museum A-007, La Jolla, CA 92093

GALAPAGOS HIKING AND SAILING EXPEDITIONS. Small groups. 1982 dates: July 7, August 4. Charters. Machu Picchu options and Chili ski options. Inca Floats, 5982N Balboa, Oakland, CA 94611 (415) 339-9095

AFFORDABLE KENYA: Wildlife, Cultures, Indian Ocean. African Safari Club. 17 days up. All-inclusive, from US, $1827. Forum Travel, 2437 Durant, Berkeley, California 94704 (415) 843-8294

GALAPAGOS ISLANDS. Economic tours from $1666. Including airfare. 4, 5, 8, & 15 days Galapagos, all meals. Options, mainland Ecuador, Amazon, Cuzco/Machu Picchu. University credit available. Joseph Colley, Last, Inc., 43 Millstone Rd., Randallstown, MD 21133. 301-922-3116

JOIN ARCHAEOLOGICAL, HISTORICAL and Biological Expeditions in various parts of the world by sharing costs. Your share of costs are tax deductible. Send $3 for a catalogue of expeditions. Have Mule Will Travel, Inc., 787 South Grade Road, Alpine, CA 92001

KENYA—Very exclusive photographic safaris for up to six, choosing your own itinerary, at Packaged Tour prices with Mervyn Carnelley, Box 79, Naivasha, Kenya

LEGENDARY PERU: 49 programs, for groups/individuals. Cuzco, Machu Picchu (overnight), Amazon, Titicaca, Nazca, Chavin, Indian Markets, etc. Extensions: Galapagos, Ecuador, Bolivia. Forum Travel, 2437 Durant, Berkeley, California 94704 (415) 843-8294

MORE TIME THAN MONEY—hints for leisurely, reasonable travel abroad, $5.85. Cherry Burns, Box 8220, Albuquerque, NM 87198

NEW ZEALAND WALKABOUT: Escorted nature and hiking tours featuring New Zealand's scenic National Parks, plus the Milford Track. Pacific Exploration Co., Box 3042-N, Santa Barbara, California 93105 (805) 687-7282

PERU: TREKKING THE INCA TRAIL. Hike through the heart of the ancient Inca empire to Machu Picchu. Explore colorful native markets and fascinating ruins in the Urubamba Valley (Sacred Valley of the Inca). July 30 - August 13, 1982 (15 days). Cost: $1190. Write: High Country Passage. P.O. Box 1100, Hamilton, MT 59840. (406) 363-2555

Pike Place Public Market, Seattle

Steve Meltzer

RATES AND STYLE INFORMATION

$1.75 per word; 16 word ($28) minimum. *Display classified* is $150 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY to: The Market, NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024. Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—1st of the month, two months prior to cover date (the January issue closes Nov. 1). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

Box numbers, telephone numbers, and hyphenated words count as two words; abbreviations and zip codes as one word each. All states are shown in two-letter code followed by zip, then telephone (with area code), if desired. Occasionally, slight editing is required for clarity. Thank you!

Celestial Events

by Thomas D. Nicholson

All Month Mars, Saturn, and Jupiter are still prominent in the constellation Virgo, near Spica, well placed from sunset until about midnight. At dusk, they appear well up in the south, brilliant Jupiter first, then Spica, Saturn, and Mars to its right. During June, Mars moves swiftly to the east, noticeably closing its distance from Saturn and Spica. Saturn moves slowly away from Spica to its right (west) until the 19th, then moves to the left toward the star. Jupiter also changes direction, approaching Spica and Saturn until the 28th, then moving away from them. By midnight, the three planets and the star are in the west, curving from Jupiter (highest) down toward the horizon. The moon joins them early in the month (on the 1st and 2nd) and again at month's end.

Venus continues to dominate the morning sky from dawn until it disappears in daylight. Although this is not a particularly favorable morning elongation for the planet, it is bright enough to be seen low in the east every morning. You may be able to see Mercury below Venus and to the left in the late twilight during the last week of June if you have an exceptionally clear eastern horizon.

June 1: The nine-day old moon, three days past first-quarter, is waxing in the sky from sunset till past midnight. It passed above Saturn earlier in the day and passes above Spica, the bright star of Virgo, tonight. Watch the moon drift slowly to the east past the star, while Saturn and Mars are to their right and Jupiter is to their left. Mercury, at inferior conjunction, passes between the earth and the sun and enters the morning sky.

June 2: The very bright object near the moon tonight is Jupiter. To their right and higher, at dusk, you can see Spica, Saturn, and Mars, in that order. The moon is in conjunction with Jupiter at about 4:00 P.M., EST, moving slowly away from Jupiter (to the left) during the night.

June 5: The reddish star below the moon tonight is Antares, in Scorpius. It should be the only star you can see near the very bright, waxing gibbous moon.

June 6: Full moon. The star well to its right and below is Antares.

June 7: The moon is at apogee, farthest from the earth. It is located in Sagittarius this evening, above the "teapot," just about where the winter solstice is located. The solstice is the most southerly location of the earth's orbit; the sun is at this point in the sky (as seen from the earth) on the first day of winter each year.

June 13: Mercury, having passed between the sun and the earth (inferior conjunction) on the 1st, ends its retrograde motion and begins moving easterly again. Now to the sun's right (west), Mercury is in the morning sky and may be seen as a morning star toward the end of the month, low in the east during morning twilight.

June 15: The earliest sunrise of the year occurs today.

June 18–19: The waning crescent moon is near Venus on both mornings, to the right and above on the 18th, to the left and below on the 19th.

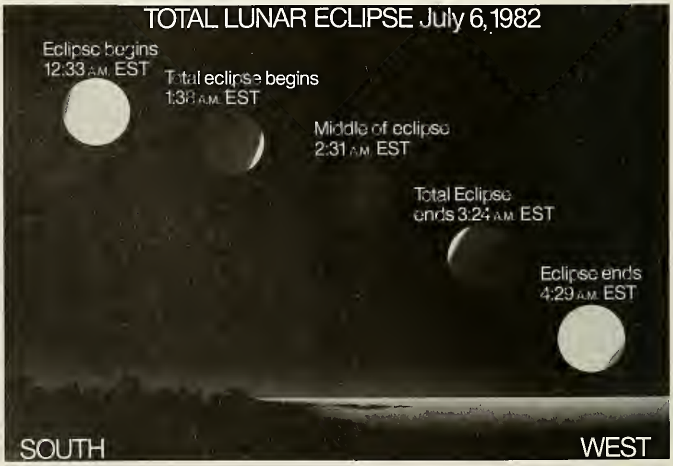
June 19: Saturn is stationary relative to the stars and resumes its direct (easterly) motion. Until now it has been moving slowly to the right away from Spica, the bright star of Virgo. Now it begins to approach Spica again. The waning moon passes Mercury today, close enough to cover the planet (an occultation) in the sky over the northern part of North America, where Mercury and the moon are above the horizon.

June 21: Three celestial events of some significance occur today. When the moon is new at 6:52 A.M., EST, it causes a partial solar eclipse over the Antarctic and parts of South Africa, the third of seven eclipses that take place in 1982. Less than an hour later, the moon is at perigee, where it is nearest the earth, and the perigee spring tide will cause substantially higher than ordinary tidal heights tonight and tomorrow morning. Finally, the sun reaches the summer solstice at 12:23 P.M., EST, and summer begins in the Northern Hemisphere. This is also the date when the duration of daylight (the "longest" day of the year) is greatest for places north of the Equator.

June 24–25: The young crescent moon may be visible during evening twilight on the 24th, and will surely be visible on the 25th. The star near the moon on both nights is Regulus, in Leo. The moon passes Regulus during the day on the 25th.

June 26: Mercury is at greatest westerly elongation (to the sun's right), and it may be seen low in the east before sunrise for several mornings before and after today.

June 27: The latest sunset of the year


TOTAL LUNAR ECLIPSE July 6, 1982
Eclipse begins 12:33 A.M. EST
Total eclipse begins 1:38 A.M. EST
Middle of eclipse 2:31 A.M. EST
Total Eclipse ends 3:24 A.M. EST
Eclipse ends 4:29 A.M. EST
SOUTH
WEST

Helmut Wimmer

(for the Northern Hemisphere) takes place today.

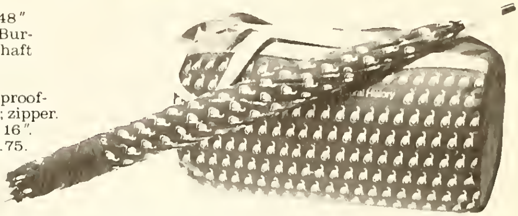
June 28: First-quarter moon occurs shortly after midnight this morning. The bright object nearest the moon (below it) is Mars. To Mars' left are Saturn, Spica, and very bright Jupiter, in that order. The moon passes Mars at about 6:00 A.M., EST; Saturn about 4:00 P.M. Jupiter resumes its normal (easterly) motion relative to the stars. The planet now moves away from Saturn and Spica (to its right), and toward the constellation Libra again. The moon tonight is between Saturn (to its right) and Spica (to its left), with Mars to the right of Saturn and Jupiter well to the left of the moon.

June 29: If you haven't met it yet, the moon will introduce you to Jupiter. At sunset they will be high up in the south, with the moon to the right and above the planet. Watch the moon move left above Jupiter, however, to pass it about 8:00 P.M., EST, and drift to its left (east) thereafter.

Editor's Note: The Sky Map in the April issue shows the evening constellations and stars for this month and gives the times for use.

Shortly after midnight on the evening of July 5–6, 1982, a total lunar eclipse will occur, the fourth of seven (the maximum number possible) that occur this year, and the first to be visible from North America (the seventh—another total lunar eclipse on December 15—will also be visible). During a lunar eclipse, the moon does not disappear completely; its shadow-covered surface is lit by sunlight bent into the earth's shadow by the earth's atmosphere, giving the moon a pale, dull, coppery red color. Times should be adjusted for other time zones and for daylight time.

DINOSAURS



Dinosaur Umbrella 48″ diam. Cotton poplin. Burgundy/Beige. Wood shaft & handle. $30. Members $27.
Dinosaur Tote Waterproof-backed cotton canvas; zipper. Burgundy/Beige. 8 x 16″. $17.50. Members $15.75.

BY MAIL

American Museum of Natural History
Museum Shop
CPW at 79th St.
N.Y., N.Y. 10024

Item	Qty	Price	Shipping/ handling	Total
Umbrella			$3.00 ea.	
Tote			$2.00 ea.	
			Order total	
			N.Y. Sales Tax	
			Total Amount	

Enclosed is my check or money order for

$ ______ ☐ Member ☐ Non-member

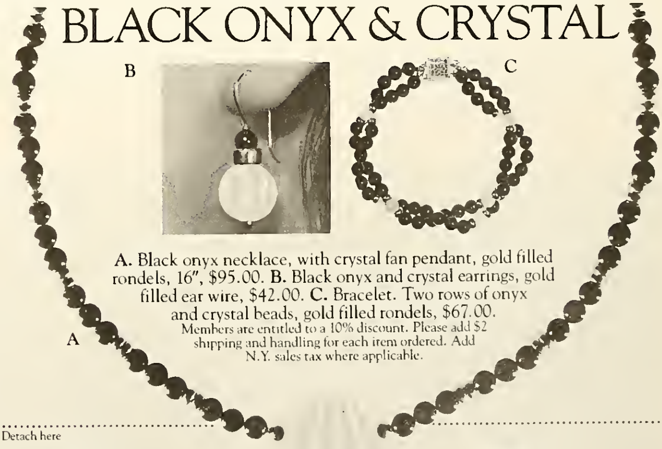
☐ Master Charge ☐ Visa ______ Account # ______ Exp. date

Name (please print) ______ Signature (required if using credit card)

Address

City ______ State ______ Zip

BLACK ONYX & CRYSTAL



A. Black onyx necklace, with crystal fan pendant, gold filled rondels, 16″, $95.00. B. Black onyx and crystal earrings, gold filled ear wire, $42.00. C. Bracelet. Two rows of onyx and crystal beads, gold filled rondels, $67.00.
Members are entitled to a 10% discount. Please add $2 shipping and handling for each item ordered. Add N.Y. sales tax where applicable.

Detach here

Museum Shop
American Museum of
Natural History
Central Park West at 79th Street
N.Y., N.Y. 10024

Please send me:
___ Necklace(s)
___ Earrings(s)
___ Bracelet(s)

I enclose a check payable to the American Museum of Natural History for

$ ______

Charge to:
☐ MasterCharge ☐ Visa

Account #
Expiration Date
Signature (required if using credit card)
Name
Address
City ______ State ______ Zip

The Journals of Ernest Thompson Seton

When the naturalist Ernest Thompson Seton was twenty, he set down a series of predictions about his future. On several sheets of paper he wrote, in part:

> In 1890 I shall marry an Englishwoman, or of English extraction; she will have light hair and blue eyes, be of medium or small size, inclined to be stout. That is, in all ways the reverse of myself....
>
> We shall have three children, two boys and a girl. The first boy will be a source of sorrow, but in the other two we shall find much happiness.
>
> In 1905 I shall by God's help, have made a comfortable fortune by my pen and pencil also by judicious speculation....
>
> In 1915 I shall be knighted by the King in recognition of my work as an artist naturalist. In 1924, I shall die in my London home, of bronchial trouble, during the spring of the year, being then in my 64th year.

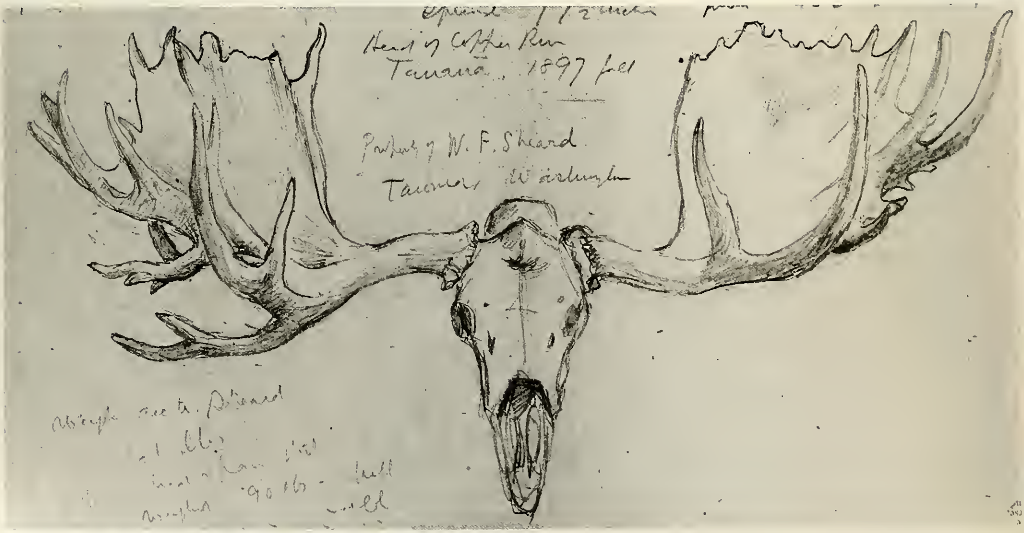
A copy of this curious document is part of the vast collection of Seton material in the manuscript collection of the American Museum's Library (which includes more than 40,000 photocopied pages of Seton's letters, notes, and other memorabilia donated by John Samson, who used them for research on a biography, *The Worlds of Ernest Thompson Seton*).

Except for the "comfortable fortune," these predictions by and large did not come to pass. What did come to pass in his life, Seton recorded in meticulous detail in his journals, which span sixty-seven years and run to thirty-five volumes. The original journals were given to the Museum by Joseph F. Cullman 3rd, a Museum trustee, and along with other documents and artwork, form the most extensive collection of Seton material anywhere in the world.

An exhibit of Ernest Thompson Seton's journals, together with photographs, manuscripts, books, drawings, and other memorabilia, is on display in the Library Gallery. Another exhibit at the entrance to the Library displays many of Seton's drawings of bears, accompanied by a collection of teddy bears on loan to the Museum. Both exhibits will remain open through the summer.

Ernest Thompson Seton was one of the most famous naturalists of his day. His first and best-known book, *Wild Animals I Have Known,* brought him instant success and was followed by a prodigious and steady output of books, articles, paintings, and drawings. In an era known for sentimentalizing animals and their life histories, Seton wrote stories based on accurate, close observation of animals. So good was his tracking that some naturalists accused him of making up the scenes he described, claiming that no one could have observed animal lives in such detail. On the other hand, sentimentalists attacked Seton for ending all his stories in tragedy and bloodshed, to which he replied: "There is only one way to make an animal's history untragic, and that is to stop before the last chapter."

Seton was born in England in 1860 to an aristocratic family (his father, had he wished, could have claimed the title Earl of Winton). When Seton was six his father lost his entire fortune and was forced to emigrate to Canada with his wife and ten sons. Ernest grew up in the backwoods of Canada; isolated and



Skull of old bull moose, with Seton's notes and measurements

AMNH

Please send me information regarding the tours I have checked:

☐ **1983 General Program**
☐ **Archeology Tour to Mexico** January 11 to 29, 1983
☐ **Ancient Maya Archeology** January 31 to February 17, 1983
☐ **East African Safari** February 2 to 20, 1983
☐ **600 Mile Nile Cruise** February 6 to 26, 1983
☐ **Indian Ocean Adventure** January 21 to February 9, 1983
☐ **Indonesian Odyssey** February 3 to 24, 1983
☐ **Anthropology Tour to Morocco** March 26 to April 9, 1983
☐ **Art and Archeology Tour to China** June, 1983
☐ **Art and Archeology Tour to Tibet and Southern China** June, 1983
☐ **Galapagos Islands Cruise with Highland Ecuador and Peru** June, 1983
☐ **Alaskan Wildlife Adventure** June 24 to July 11, 1983
☐ **Cruise Through Scandinavia** July, 1983
☐ **Art and Archeology Tour to China** (The Silk Road) September, 1983
☐ **Anthropology and Ornithology Tour to Papua New Guinea** October, 1983
☐ **Ornithology Tour to East Africa and the Seychelles** October, 1983

American
Museum of
Natural
History

Discovery Tours

Central Park West at 79 St.
New York, NY 10024
(212) 873-1440

NAME PLEASE PRINT

ADDRESS

CITY STATE ZIP

6/82

No Postage
Necessary
If Mailed
In The
United States

Business Reply Card
First Class Permit No. 2984 N.Y., N.Y.

postage will be paid by

American
Museum of
Natural
History

Discovery Tours

Central Park West at 79th Street
New York, New York 10024

Discover the World with the
AMERICAN MUSEUM OF NATURAL HISTORY IN 1983

You are invited to join renowned Museum experts on custom-designed cruises and land programs to the most fascinating destinations in the world.

Alaskan Wildlife Adventure
Cruise through Scandinavia
Art and Archeology Tours to China and Tibet
Archeology Tour to Mexico
Ancient Maya Archeology
Moroccan Anthropology
Nile Cruise
Indian Ocean Adventure
East African Safaris
Galapagos Islands Cruise
Indonesian Odyssey
Papua New Guinea Tour

INDIAN OCEAN ADVENTURE
January 21 to February 9, 1983

Visit India, Sri Lanka, Burma, Thailand, Malaysia and Singapore on a luxury cruise exclusively designed by the American Museum. Join Dr. Thomas D. Nicholson, Director of the Museum, and a Museum anthropologist, botanist, geologist, and ornithologist for a unique exploration of diverse cultures related by Hindu-Buddhism, and exotic natural habitats. Our luxury ship will be the "Illiria" which is exclusively chartered by the American Museum.

INDONESIAN ODYSSEY
February 3 to 24, 1983

Immediately following our Indian Ocean Adventure, the "Illiria" will sail from Singapore to Java, Lombok, Komodo, Flores, Butung, Sulawesi, and Bali. Share with a Museum anthropologist, geologist, botanist and naturalist an exciting voyage stopping at lush tropical islands with volcanic landscapes to visit fascinating local cultures. Both the Indian Ocean Adventure and this program may be combined for a six-week voyage throughout Southeast Asia.

NILE CRUISE
February 6 to 26, 1983

Explore the astounding ancient sites and natural wonders of Egypt with a Museum geologist, ornithologist and Egyptologist. Cruise 600 miles on the Nile from Cairo to Assuan aboard the custom-built, air-conditioned "Nile Star" stopping at all the important sites which have intrigued visitors for 4000 years.

GALAPAGOS ISLANDS CRUISE
June of 1983

Discover a special natural world with fantastically tame and exotic animals such as sea lions, giant tortoises, marine and land iguanas and countless rare and beautiful birds. Enjoy the expertise of a Museum ornithologist and geologist as we cruise through this equatorial archipelago which so influenced Darwin. Excursions in highland Ecuador are included in the tour, and an optional extension to Peru's archeological sites is scheduled.

CRUISE THROUGH SCANDINAVIA
July 28 to August 15, 1983

The Museum announces its first cruise through the North and Baltic Seas. Visits will be made to Bergen, Flamm, Gudvangen, Oslo, Copenhagen, Oland, Visby, Stora Karlso, Stockholm, Tallinn, Helsinki and Leningrad, in an extraordinarily comprehensive Scandinavian cruise. Join our expert lecturers on this rich cultural and natural history program aboard the luxury ship "Illiria."

LAND PROGRAMS
Ten outstanding overland itineraries have been custom-designed for small groups of 15 to 25 participants. China...Alaska...Tibet...Mexico...East Africa...Papua New Guinea...Famous and remote sites and cultures are discovered while staying at the finest accommodations available with distinguished Museum lecturers.

American
Museum of
Natural
History

Central Park West at 79th Street New York, N.Y. 10024 (212) 873-1440

For further information concerning the Discovery Tours program mail **the attached card** to the Museum's travel office or call (212) 873-1440.

Moving

Please give us 8 weeks notice. Attach your label and print your new address below.

Renewing

Your label shows your last issue in your current subscription in the top right corner. For uninterrupted service, include your label with your order—print any changes or corrections in the space below. Rate—$15 per year, add $5 outside U.S.

Fuming

If you should have a complaint or a question, we can give you faster results when you send your label with your problem.
Unlisting service—If you do not want your name included in the list of Natural History subscribers rented to selected mail advertisers, check the box below and send the coupon with your label.

PLEASE USE YOUR MAILING LABEL

or copy your name and address as it appears on your label in the space below.

NATURAL HISTORY
P.O. Box 4300, Bergenfield, N.J. 07621

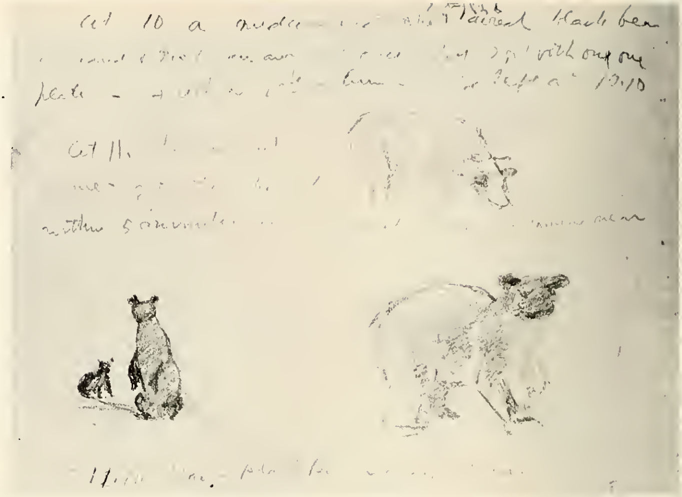
☐ New Subscription
☐ Gift Subscription
☐ Renewal
☐ Please remove my name from your mailing list

PLEASE PRINT
Name
New Address
City State Zip

PLEASE ATTACH MAILING LABEL
Name
Address
City State Zip

Seton's favorite subject—the bear

AMNH



lonely, he became intensely interested in the workings of nature, drawing and describing what he saw in precise and accurate detail.

Seton was very proud of his journals, into which went all his firsthand observations and preliminary sketches, and out of which he extracted the material for his more than forty books, numerous paintings, and hundreds of articles. He rarely wrote about himself in the journals, and according to his friends, he had few weaknesses other than a certain vanity about his appearance. He was fond of clothes that would attract attention, and photographs show him with long, flowing hair and a carefully trimmed, waxed moustache.

Seton's journals are stored on several shelves in the Museum's Rare Book Room, nestled between Roy Chapman Andrews's Mongolian journals and some miscellaneous Latin and Russian books. The word "journal," or "diary," does not accurately describe this eclectic compendium of notes, artwork, and pressed specimens. Opening a journal at random, one is apt to find almost anything: feathers, wool, pressed flowers, dinner menus, maps, pencil sketches, complex little watercolors, pen-and-ink drawings, photographs, fur, moss, grass, rootlets, postcards, and so on. Each book, furthermore, has a handwritten index. Seton never stopped observing, and consequently there is a journal entry for most days of his life. If you want to learn what Seton was up to, for example, on August 23, 1907, you simply turn to the appropriate diary: "Saw a parasitic jaeger pursue and capture a Lapland Longspur in the air. The bird dodged and twisted but the jaeger kept close to it, turning somersaults, and finally caught it and made off with the bird in his bill."

Or July 2, 1888: "*Robin's* nest in low pine bough . . . had today 2 eggs. At Lorne Park today I heard *Song Sparrow* singing a song later–chuck chuck chuck brrrrrrrr—like an abbreviated remnant of its ordinary song."

Or September 18, 1893: "Boston. Went to Wellesley College. Passed the day with Miss Caroline Fitz Randolf. She was in a terrible rage about something the professor had said to her. . . . *Another idol shattered.*"

The first entry in book one, volume one, was written when Seton was en route by boat to London to study art:

"Fri 13 June [1879]. Arrived Kingston 3:30 A.M. From 6 to 9. We are now passing through the 1000 isls. They are as monotonous collectively as they are picturesque individually, being varied only in size and all like this [pencil sketch]."

Other volumes contained numerous plant specimens and detailed drawings of everything from mountain lions, animal tracks, and maps of gopher burrows to painstakingly rendered watercolors of animal droppings. Very little of what he wrote from 1879 until his death in 1946 is legible to the unpracticed eye, although a skilled biographer or archivist would have no trouble deciphering the erratic, flowing hand.

One incident in particular reveals Seton's strong feelings about his journals. In the March 1904 issue of the *Atlantic*

Monthly, an article by the naturalist John Burroughs mounted a scathing attack on Seton, calling him a fraud and a sham naturalist. To prove to Burroughs that he had based all his animal stories on scientific observation, Seton brought the crusty old man to his house. First he showed Burroughs his "museum" of animal and bird skins, his library, and his artworks. "But when," Seton wrote, "I showed him . . . last of all, my journals, some thirty fat volumes, detailing my travels and observations during thirty years, he broke down and surrendered. 'I had no idea' 'I never dreamed, etc.—,' he said again and again. 'I knew nothing of this, etc.—' He, himself, never kept a journal, never made a drawing and never skinned a bird or a beast in his life. He was not a naturalist, but a Poet. . . ."

Seton rarely, if ever, wrote about his feelings. His journal entries are usually dispassionate and understated, even when describing the inevitable scenes in nature of death, of sickness and bloodshed, of pursuit and capture. The last entry in his journals, some ten shelf-feet away from the first entry quoted above, is typically brief and to the point. It is written on a piece of torn paper taped to the page: "1946 1st day in hospital Sat. Aug. 31st. Home from hospital Fri. Sep. 6th. . . . " For a man who filled every available space on the page with writing and sketches, uncharacteristically this entry is followed by blank pages.

Douglas J. Preston

Nayjama

On Wednesday, June 23, at 7:30 P.M. in the Auditorium, the Education Department is presenting a concert of ancient Aymara and Quechua music by the group *Nayjama*. Using wind instruments and drums, the musicians evoke the festivals and rituals that remain an element of community life in the villages of the Andes where the Aymara and Quechua peoples—descendants of the ancient culture that flourished near Lake Titicaca before the Inca Empire—live. In addition, the group will offer a selection of music that has evolved through the blending of Spanish and native cultures in the *altiplano*. Tickets for the performance are $6 ($5 for members) and may be obtained from the Education Department.

Geology at Sunset

A three-hour sunset boat tour around Manhattan Island, organized by the Museum's Education Department, will take place on Tuesday, June 29, from 5:30 to 8:30 P.M. The tour will survey the unusual geology of Manhattan and vicinity, focusing on the origins of the Palisades, the city's one-billion-year-old bedrock, the geologic fault near Gracie Mansion, and the place where the Hudson River once sliced Manhattan in two. Sidney S. Horenstein, a geologist with the Museum, will lead the tour. The fee is $18 per person, $15 for members.

The Politics of Creation

Fundamentalist creationism, thought to have become obsolete with the Scopes "monkey trial," has had a resurgence. Scientific theories and statements by eminent scientists have been misconstrued by the "scientific" creationists to support their *Genesis*-based hypothesis of creation. On Wednesday, June 9, at 7:30 P.M. in the Auditorium, noted scientist and *Natural History* columnist Stephen Jay Gould will present a slide-illustrated lecture exploring current theories of evolution in the scientific community. He will then focus on how the creationists distort scientific principles to achieve their own ends. Tickets for the lecture will be $2.00 for members and $4.00 for nonmembers. Please call the Membership Office for ticket availability.

Einstein Portraits

An exhibit of photographs of Albert Einstein is currently on display in the Planetarium exhibit gallery. The photographs were taken by Einstein's good friend Lotte Jacobi, an internationally known photographer. The exhibit complements *The Universe of Albert Einstein*, the current Sky Show at the Hayden Planetarium.

Crystal Odyssey

A new Laserium show has opened at the Hayden Planetarium. Using new and bolder laser images, *Crystal Odyssey* takes the viewer on a trip through space and time, to a musical score featuring works by J. S. Bach (Brandenburg Concerto no. 3), Rimsky-Korsakov ("Flight of the Bumblebee"), Ravel ("Bolero"), Stravinsky (*La Sacre du Printemps*), and George Crumb ("The Advent"). The show includes the first use of an argon laser in a Planetarium show. *Crystal Odyssey*, according to its creator Ivan Dryer, was inspired by Walt Disney's *Fantasia*, and uses different lasers to create strange and fantastic images on the dome of the Planetarium.

For more information about programs listed in this section, call the appropriate department: Education Department (212) 873-1300; Membership Department 873-1327; Hayden Planetarium 873-1300. Or write to the department at the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024.

Better Than Jogging

NordicTrack

Jarless Total Body Cardiovascular Exerciser

Duplicates X-C Skiing for the Best Motion in Fitness

Highly Effective and Pleasant To Use
The enjoyable sport of cross-country skiing is often cited by physiologists as the most perfect form of cardiovascular exercise for both men and women. Its smooth, fluid, total body motion uniformly exercises more muscles and higher heart rates seem easier to attain than when jogging or cycling. NordicTrack closely simulates the pleasant X-C skiing motion and provides the same cardiovascular endurance-building benefits — right in the convenience of your home. Makes a year round, consistent exercise program easily attainable. Eliminates the usual barriers of time, weather, chance of injury, etc. Also highly effective for weight control.

Better Than Running
NordicTrack gives you a more complete work out — conditions both upper body and lower body muscles at the same time. Fluid, jarless motion will not cause joint or back pains as jogging or running often does.

Better Than Exercise Bikes
NordicTrack's stand-up skiing motion more uniformly exercises large leg muscles and also adds important upper body exercise. Higher pulse rates, necessary for building fitness, seem easier to attain because the work is shared by more muscle mass. The NordicTrack also keeps more muscles in tone.

Even Better Than Swimming
NordicTrack more effectively exercises the largest muscles in the body, those located in the legs and buttocks. These muscles' main function is to lift and propel the body in the standing position. However, when swimming, the body is supported by the water, thus preventing these muscles from being effectively exercised. The stand up exercising position on the NordicTrack very effectively exercises these muscles.

A Proven, High Quality Durable Product
Ruggedly constructed, NordicTrack is quiet, motorless and folds compactly for storage. Separately adjustable arm and leg resistances. NordicTrack is in its 5th year of production and is used in thousands of homes and many companies. We manufacture and sell direct. Our No-Risk 15 day trial guarantee shows our confidence in your being pleased with the performance and quality of the NordicTrack.

For more information, call or write
PSI 124 L Columbia ct. Chaska, MN 55318
toll free 1-800-328-588B 8 – 5 Mon – Fri
Minnesota 612-448-6987

Hooked

Independent Long Island fishermen still follow the ways of their ancestors

by Raymond Sokolov

Don Eames did not enjoy himself much away from home at butcher school in Toledo, Ohio. He wasn't, moreover, giddy with delight when he tried his hand at roofing. Eventually, after giving both of these careers a serious try, Don concluded that they were entirely too earthbound for him. He shrugged and went back to fishing.

This was no idle gesture on his part. When Don Eames heads for the water near his birthplace on the East End of Long Island, he has no intention of goofing off. But he takes no rod or reel, no cunning lures, no teak-decked skiff. Don has never taken a fly-casting course at Orvis. But he is my idea of a "compleat angler." He fishes for cash, for survival. He's a pro. And in his part of Long Island, Don is continuing the world of his ancestors, who went out in small boats in all kinds of weather, netting and spearing and trapping and digging for whatever the sea produced.

Don is no specialist; with his friend Calvin Lester, he fishes on the modest scale of olden days. In warm months, the two young men set enormous nets and go for the standard fish of the area, competing with the sport fishermen from New York City who cast into the surf on the same beach where Don and Calvin spread their purse seines.

At other times of the year, you might come upon these good-natured, gregarious fellows chopping through the ice in search of eel or dredging the bottom for bay scallops. Their boats are not fancy. Plywood is a basic material in the construction of these Bonacker "Chris-Crafts," which sit like hibernating hippos in Bonacker backyards when they are not in the water.

Bonackers are the year-round, working populace of the South Fork of Long Island. Named after Accabonac Creek, they live in modest streets and agglomerations of homes tucked away all over the flat, sandy rural land better known to the outside world for its posh resort

Below: A seine set for perch in Oyster Pond, near Long Island's eastern tip, is hauled in. No perch were caught but one of the fishermen found striped bass frozen at the pond's edge, right.

Photographs by Adelaida de Menil

AlaskA
TRAVEL ADVENTURES

Where Adventure Begins
We feature:

- Backcountry Adventures
- River Trips
- Inside Passage
- National Parks
- Fishing

Call for free brochure describing 50 adventures:

Toll Free: 800-227-8480
Northern Cal.: 415-329-9013
Southern Cal.: 213-859-3959

Alaska Travel Adventures
525 University Ave #610-AV
Palo Alto, CA 94301

NORTHWEST ORIENT
THE WORLD IS GOING OUR WAY!

NATURAL HISTORY MAGAZINE BINDER

The functional way to save your full year's issues for future reference and pleasure. "Natural History" stamped in gold color on dark green leatherette over heavy binder's board. 12¾" x 9". Price $6.50. Members $5.85.

American Museum of Natural History
Museum Shop
Dept. 229
C PW at 79th St.
N.Y., N.Y. 10024

Qty	Price	Shipping/ Handling	Total
		$2.00 ea.	
		Order Total	
		N.Y. Sales Tax	
		Total Amount	

Enclosed is check/money order for $ ________

Name

Address

City State Zip

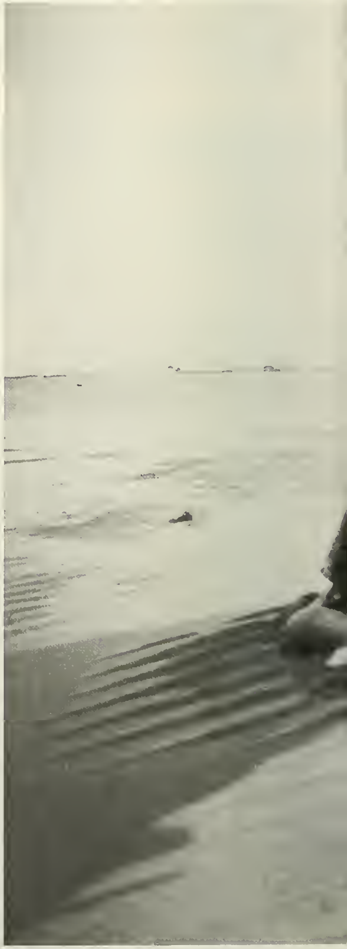
cottages. Manhattanites flock there in the summer and call the area The Hamptons because of its villages: East Hampton, Southampton, Bridgehampton. Bonackers, whose roots in the place run centuries deep, call it the South Fork, from the shape of Long Island at its easternmost extremity.

The island as a whole is something like a great whale on a collision course with Manhattan. Its flukes are out at sea, two large peninsulas, or forks, roughly one hundred miles west of the city. Because of their isolation from the metropolis and their marine way of life, Bonackers have more in common with New England fisherfolk and even speak with a variation of the Down East accent usually associated with Maine.

The most remarkable thing about Bonackers these days—what sets them apart even from other fishermen of the American Northeast—is the small scale of their enterprise, its traditional methodology. You won't find them in factory trawlers. Fishermen like Don Eames and Calvin Lester go out in dories they can run themselves. In some months, they dispense with boats altogether and just tramp out across the shoals at low tide, quarrying the mud for clams. When I met them last winter, the bottom had fallen out of the scallop market because of killing competition from southern beds. A storm had messed up the tides and Napeague Harbor was still covered with water, not enough of it to deter a hyperkinetic Irish setter from cantering out and splashing across the inlet, but it did keep Don and Calvin from getting out far enough to rake where the soft clams were abundant. They dug near the shore, finding just enough *Mya arenaria* to feed a family for dinner. These are the clams usually eaten steamed or fried. They never close completely and tend to take in sand that must be purged before they are pleasant to eat. Careful people keep them in clean water for a day or two. They survive this treatment quite nicely.

Pulling them out of the mud is not such a simple matter. Where steamers are plentiful, Don and Calvin go after them with a specially modified pitchfork. Like many of the pieces of equipment lying in their yards, they have altered it to suit the exigencies of their work as small-time commercial fishermen. At the throat of their clamming pitchfork, where the handle meets the five-tined fork, there is a metal ring. From this ring, a sawed-off section of heavy dowel cut from a spade handle swivels and functions as a second handhold for the pitchfork. It comes in very useful for pulling the pitchfork out of the mud, straight up, so that the clams stay on the tines while the mud washes away. Because soft clams live relatively far under the surface of the mud, this double-handle mechanism is a great convenience for a fisherman, who is already obliged to slog about in cold water, stoop over and force his pitchfork into the mud, and then, having extracted his clams and dumped them in a wire basket floating in an inner tube trailing behind him from a rope attached to his waist, must avoid swooping, piratical gulls eager to raid his cache of toothsome bivalves.

Such foraging takes place in a dune-filled section of East Hampton Town called Napeague, at Lazy Point. It is a somewhat bedraggled, uncelebrated



By attaching a special rake to a harness around his waist, fisherman Don Eames can throw his whole body into the job of clamming for hard shells in Lake Montauk.

At low tide, a fisherman uses a clam hook to gather steamers off Lazy Point in Napeague Harbor. A clam fork, which is used at half tide, would break the clam shells.

corner of the Hamptons, once lovingly described by Everett T. Rattray, late editor of the *East Hampton Star*, in his book *The South Fork*:

> "The Napeague ospreys Grandpa plagued with the auto horn were fond of fishing in Pond of Pines, a small tidal pool off Napeague Harbor, just south of Lazy Point Road. Pond of Pines runs to the harbor through a channel meandering between banks overgrown with salt-meadow hay and spike grass. On the banks hang mussels; in the channel's shoals hide razor clams, hard clams, and steamer clams. In the mud of the pond proper are blue-claw crabs; in its eelgrass lurk scallops and small minnows, killies. The diamond-backed terrapin has been seen at Pond of Pines, and egrets, night herons, and great blue herons feed regularly in its shallows. The hundreds of acres of salt marsh running off to the east, south, and west are the year-round hunting grounds of various hawks, and the dunes to the north . . . are tracked by black snakes, and now and again a red fox. Toward the bay there is a small village of fishing shanties and summer camps. . . . Quaint, say the few tourists who ever find this out-of-the-way hamlet; an anachronism and in violation of health and building codes, say the planners; a nuisance, say the [East Hampton] Trustees; leave us alone, say the Lazy Pointers.

Call it rugged individualism or whatever you like. The independence of the Bonacker fisherfolk matches the landscape where it subsists, an orphan of historical forces. Not long ago in Napeague, a big menhaden processing plant flourished, until the consolidation of the fishing industry forced its phasing-out. The same trend makes it harder for self-employed fishermen in dories to compete with factory ships. Nature has dealt the likes of Don and Calvin a bad hand. Because of abundant supplies in other waters, shellfish prices are down, while everything else costs more.

Times are not what they were for Bonacker fishermen when Calvin's eighty-year-old grandfather was young. He remembers when sturgeon, some weighing several hundred pounds, were so plentiful off the South Fork that he devoted himself exclusively to catching them. His grandsons occasionally see a relatively modest three-foot-long sturgeon. Still, they seem to make a living, precarious and probably without strong long-range prospects, but it beats cutting beef indoors or nailing shingles on summer days.

Raymond Sokolov's new book, Fading Feast *(Farrar, Straus and Giroux), is a collection of food columns that first appeared in* Natural History.

Fish Chowder

(from *Ready When You Are*, by Elizabeth Schneider Colchie. Crown, 1982)

1 tablespoon coarse (kosher) salt
2 medium-size garlic cloves
1 teaspoon fennel seeds
¼ teaspoon dried thyme
2 pounds lean fish fillets (cod, hake, haddock), cut into 2-inch pieces
1–2 large fish skeletons (heads and bones, about 2 pounds) of lean white fish
6 cups water
1 cup dry white wine
3–4 medium-size onions, thinly sliced (to make 4 cups)
¼ cup olive oil
¼ cup all-purpose flour
2 teaspoons dried basil
½ teaspoon dried summer savory
1 bay leaf, crumbled or snipped into small pieces
½ teaspoon saffron threads, steeped in ¼ cup hot water
1¾ pounds large new potatoes, peeled and sliced into pieces about 1 inch square and ¼ inch thick (about 5 cups)
½ cup (approximate) light or heavy cream
Minced fresh basil or thyme (optional)

1. Crush together 1 teaspoon of the salt, 1 garlic clove, the fennel seeds, and the dried thyme in a mortar, or chop fine with a heavy knife. Rub the mixture evenly over the fish pieces, then cover with plastic and refrigerate overnight or leave several hours at room temperature.
2. Remove the gills from the fish heads. Chop the skeletons into manageable pieces and combine with the water in a large pot. Simmer, partly covered, for 5 minutes. Scrape off any large pieces of meat from the bones and refrigerate them. Return the bones to the pot; add the wine and simmer gently for 20 minutes. Strain through a sieve, then through fine-mesh cotton cheesecloth. Set aside.
3. In a large soup pot, cook the onions in the olive oil until very soft. Slice the remaining garlic, add to the pot, and stir for a minute. Add the flour and stir and scrape for about 2 minutes. Pour in the fish stock and add the dried basil, savory, bay leaf, saffron, and the remaining 2 teaspoons salt. Bring to a boil, stirring.
4. Add the potatoes and simmer gently for about 15 minutes, or until the potatoes are not quite cooked through. Stir in the reserved raw and cooked fish. Gently stir for about 1 minute, or until the outside of the fish turns white, but the fish is not cooked through.
5. Set the pot in a sink containing cold water. Stir the soup now and then until cool. Refrigerate, covered, overnight.
6. *To serve:* Warm the soup over low heat, stirring gently so as not to break up the fish. Add the cream to taste and stir; sprinkle with the fresh herbs if available.

Yield: Six servings

In my column on "White Lightning" in the December 1980 issue of *Natural History*, I included the following comment from Kermit W. Salyer, former editor and publisher of the *Franklin News-Post*, of Rocky Mount, Virginia:

> Salyer contends that the whiskey interests in Franklin County have tried to put him out of business by setting up a rival newspaper, which siphons off advertising and circulation that might otherwise go to the *News-Post*.

Neither I nor *Natural History* meant to impugn the reputations of T. Keister Greer, Malcolm Donald Coe, and the late Flanders B. Callaway, who founded a rival newspaper, the *Franklin County Times*, in 1968. Greer, member of a family which has been in Franklin County for more than 200 years, was a Marine officer in World War II, and is now chairman of the county's largest bank. He has an active law practice in Virginia and California.

Malcolm Donald Coe, who received a master's degree in journalism from the University of Missouri, has been a faculty member of the University of South Carolina and the University of Alabama. He is president and owner of Bassett Printing Corp., of Bassett, Virginia, a multimillion dollar concern.

The late Flanders B. Callaway was a member of a family identified with Franklin County since its formation in 1785. A civic leader, he had been president of the Rotary Club, president of the Franklin County Historical Society, and an elder in the Piedmont Presbyterian Church.

I regret that, in quoting Mr. Salyer, I may have given rise to the implication that these three gentlemen and the newspaper founded by them, the *Franklin County Times*, were connected with whiskey interests in Franklin County. This is by no means the case. I apologize for any unintended damage to the reputations of Mr. Greer, Mr. Coe, and the late Mr. Callaway my article may have caused.

GETTING A LONG TERM CAR LOAN? DON'T GET A SHORT TERM CAR.

Some of the figures you hear rattled off in banks these days can be downright frightening.

Interest rates on car loans have been as high as 16%. And car loans can now run as long as four years.

Paying one back is starting to look a little like settling the entire national debt.

If you're going to sign up for that kind of commitment, make sure you select a car that justifies it. One that will last longer than the payment book.

Consider a Volvo. Volvos have always had a reputation for lasting a long time in Sweden. And recent findings show they do well in this country, too. In fact, the life expectancy of a Volvo is 1/3 longer than the average life expectancy of all other cars on the road.*

What's even more important, Volvo's long list of comfort and performance features make it the kind of car you'll want to keep for a long time.

So this year, finance a Volvo. You may not laugh all the way to the bank. But you won't cry, either.

VOLVO

A car you can believe in.

*Analysis conducted by Ken Warwick & Associates, Inc. Based on a comparison of U.S. registration data for Volvo and for the automobile industry as a whole and not by individual make. Summary available at your Volvo dealer. © 1982 Volvo of America Corporation.

They cut diamonds by hand. Don't they?
Waterford

Photo: Pesin

Rare diamonds born deep in the heart of the earth.

Waterford crystal born of fire in Ireland.

The two trusted to the sure hand of a master cutter; one no more than the other.

Waterford is indeed cut by hand with heart. Not only the deep diamonds, but the notched edges, the wedge cuts, the faceting, the ovals, the sum & total of Georgian motifs so characteristic of old Waterford.

Now you know why crystal connoisseurs give the master cutters of Waterford a resounding hand.

Illustrated booklet. Waterford Crystal, 225 Fifth Avenue, New York 10010

NATURAL HISTORY

$2

7/82

Volkswagen introduces luxury widebodies.

With all the juicy enticements the airlines have used to get more people traveling their way, we thought we'd offer one of our own.

It's called the Vanagon GL. And it's first class all the way.

From the seven luxurious velour upholstered seats (each with arm rests), to the thick carpeting everywhere you step.

To the magazine pockets.

To the overhead reading lights.

To the European styling and color coordinated interiors in rich browns. Or royal blues.

Even the ride is nice. It has independent suspension and extra soundproofing to make any journey smoother and quieter.

Whether it's a trip to the Grand Canyon.

Or just down the street to Ralph's.

What's more, the Vanagon GL is incredibly fun to drive. All 200 cubic feet of it. It handles better than a lot of cars.

And, if you consider the optional diesel* engine, you might save enough money riding our way, to go just about anywhere you want flying theirs.

*EPA estimated 29 mpg. Use for comparison only. Actual mileage varies with speed, trip length and weather.

All seats first class.

Nothing else is a Volkswagen.

© 1982 VOLKSWAGEN OF AMERICA, INC.

Gulf is van pooling.
Because one van is worth 1,000 gallons.

Every van Gulf operates replaces up to six cars. That saves 1000 gallons of gas every 35 workdays.

Every morning 3,204 Gulf employees who used to drive their own cars to work now make the trip in vans. And the energy savings are really amazing.

With 12 people to a van making an average daily round trip of about 50 miles, we figure that each van, by replacing 6 cars, saves 1,000 gallons of gasoline every 35 working days.

Collectively, Gulf's van fleet saves over 7000 gallons of gas a day.

With 267 employee-financed vans now operating at twenty-two Gulf facilities, we save 7,629 gallons of gasoline every working day! Of course, van pooling isn't the only way Gulf conserves energy. We cut fuel consumption of our tank-truck fleet almost 18%, and of our refineries by 21%, compared to 1972.

Energy conservation is a tremendous challenge, but we have to meet it if this country is ever to become less dependent on expensive imported oil in the future. It's only reasonable that Gulf, as one of America's leading energy producers, should work just as hard at being one of America's energy savers.

We put together a how-to-do-it booklet to make it easier for other companies to start van pooling. We'll be glad to send you a copy. Just write to Gulf Oil Corporation, General Service Dept., P.O. Box 2001, Houston, Texas 77001.

Gulf

Gulf people: energy for tomorrow.

©Gulf Oil Corporation 1981

NATURAL HISTORY

Vol. 91, No. 7, July 1982

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director

4 **Authors**

6 **Piping Water to the Treetops** *Martin H. Zimmermann*
The sophisticated plumbing of trees enables the important uppermost leaves to survive.

14 **This View of Life** *Stephen Jay Gould*
The Oddball Human Male

24 **Winners of the 1982 Natural History Photographic Competition**
A colorful sixteen-page portfolio of images from nature.

40 **Born Again Seal** *Gerald F. Carroll*
This largest of all seals (males can weigh 8,000 pounds) once was reduced to a herd of about 100 animals.

48 **Revelation of the Great Temple** *H.B. Nicholson*
Mexico's great new archeological project began with a chance discovery in the middle of the night by diggers from a utility company.

60 **Sky Reporter** *Douglas Richstone*
Encounters of the Galactic Kind

66 **Celestial Events** *Thomas D. Nicholson*

68 **Additional Reading**

70 **Books in Review** *Caryl P. Haskins*
An Encyclopedic Tour de Force

74 **At the American Museum** *Sidney Horenstein*
Father Knickerbocker the First

76 **A Matter of Taste** *Raymond Sokolov*
Fish, Fresh from the Farm

Cover: *During subzero weather, ducks and geese find haven in a heated pond in suburban Minneapolis. Robert M. Friedman took this winner of the Cover Photograph Award in the 1982 Natural History Photographic Competition. A portfolio of other winners begins on page 24.*

Alan Ternes, Editor
Judith Friedman, Managing Editor
Thomas Page, Designer
Board of Editors: Carol Breslin,
Sally Lindsay, Frederick Hartmann,
Vittorio Maestro, Rebecca B. Finnell
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
E. Kay Danzig, Art Asst.
Kay Zakariasen, Picture Editor
Douglas J. Preston, Publications Editor
Annie R.C. Finch, Editorial Asst.
Lillian Berger
Editorial Advisers:
Malcolm Arth, James W. Atz,
Niles Eldredge, Kenneth L. Franklin,
E.Craig Morris, Norman Newell,
Thomas D. Nicholson, Martin Prinz,
Gerard Piel, Nina Root

David D. Ryus, Publisher
L. Thomas Kelly, Associate Publisher
Bradford D. Smith, Business Manager
Frederick E. Grossman, Production Mgr.
Debra Buck McCord, Asst. Production Mgr.
Ernestine Weindorf, Administrative Asst.
Elaine M. Callender, Advtg. Production Mgr.
Carol A. Midkiff

Cary Castle, Circulation Manager
Jeff Pieper, Assoc. Circulation Mgr.
Ramôn E. Alvarez, Asst. Circulation Mgr.
Frank Stevens, Circulation Asst.

NATURAL HISTORY *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024.*
Subscriptions: $15.00 a year. In Canada and all other countries: $20.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.

Copyright © 1982 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.*

Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225

Subscription orders, change of address notices, undeliverable copies, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

Authors

A native of Switzerland, **Martin H. Zimmermann** began working at Harvard University's Harvard Forest in Petersham, Massachusetts, in 1954. Since 1970, he has been Charles Bullard Professor of Forestry and director of the Harvard Forest. For a number of years, Zimmermann studied the movement of sugars in the food-conducting tissues of trees. He has also analyzed the development patterns and the complex vascular systems of palms and other arborescent monocotyledons. Recently, he has concentrated on the structural aspects of the ascent of sap in trees. Zimmermann's research interests have taken him to tropical rain forests, as well as beyond both polar circles.

Gerald F. Carroll retired from the United States Air Force in 1977, having served twenty years. He thereupon enrolled at the University of California, Santa Cruz, to further his interest in marine biology. This subject has become the focus of his second career as a free-lance writer and photographer. He has participated in a study on the succession of intertidal invertebrates in an area once polluted by raw municipal sewage and is planning to do work on territorial competition between limpet species on the West Coast. Carroll writes that he is a devotee of sailing and also enjoys organic gardening.

As a specialist in the cultural history of pre-Hispanic and early colonial Mesoamerica, **H. B. Nicholson** has maintained close contact with the ongoing excavation of the Great Temple of Mexico-Tenochtitlan in Mexico City. The project is being conducted by Mexican archeologists under the direction of Eduardo Matos Moctezuma. Professor of anthropology at the University of California at Los Angeles, Nicholson has done extensive archeological and ethnohistorical research on ancient Mexico, with special emphasis on the sociopolitical, ideological (particularly religious), and aesthetic spheres of civilization. His current major undertaking is the Aztec Archive Project, the preparation of an organized master data file, including photographs, slides, and drawings, of all significant Aztec-style pieces in public and private collections in Mexico, the United States, and Europe.

ON DEMAND FOUR WHEEL DRIVE.

MAXIMUM TRACTION.

IN MINIMUM TIME.

The only cars in America you can switch into four wheel drive without stopping are made by Subaru.

All other 4WD's, without exception, require a full stop before switching. But with *On Demand* Four Wheel Drive, the instant you need extra traction and safety, you simply flick the lever.

And immediately you go from full time Front Wheel Drive to Four Wheel Drive. (For tougher going, certain models offer a dual range gear box). Only Subaru gives you the advantages of both Front Wheel Drive and 4WD in one road hugging car.

Our Hatchback, Wagon and Brat are also great performers in other ways as well. Like:

27 EPA EST. MPG* 36 EPA EST. HWY.*

Great gas mileage. Our entire line of 4WD's, for instance, is #1 among all 4WD cars in fuel economy.

Low sticker price. We offer the lowest priced 4WD car in America. In fact, our 4WD's actually cost less than many cars with conventional 2 wheel drive.

Optimum options. The Hill-Holder™, a device on certain models that prevents drifting back on steep hills. Power windows.** Power steering.** Stereo/cassette. Cruise control.

Terrific value. For all of the above reasons, and many more, Subaru delivers maximum value per dollar. Not to mention independent suspension on all 4 wheels, rack and pinion steering and power assist front disc brakes as standard equipment.

Also standard are two features that come with every Subaru: reliability and durability. And you don't have to demand them. We do.

SUBARU®

INEXPENSIVE. AND BUILT TO STAY THAT WAY.

*1982 EPA ESTIMATES FOR OUR 4WD HATCHBACK. USE EST. MPG FOR COMPARISONS. YOUR MILEAGE MAY DIFFER DEPENDING ON DRIVING SPEED, WEATHER CONDITIONS AND TRIP LENGTH. ACTUAL HWY. MILEAGE WILL PROBABLY BE LESS. **AVAILABLE ON CERTAIN MODELS

© SUBARU OF AMERICA, INC. 1982

Piping Water to the Treetops

The hydraulic architecture of a tree supplies its topmost leaves with water while at the same time protecting it from drought and injury

by Martin H. Zimmermann

The topmost leaves of a tree are the most important ones because these are the leaves with which the tree competes with its neighbors for a place in the sun. They are also the most expensive leaves to maintain because water and soil nutrients have to be brought to them over longer distances and lifted to greater heights. Lower leaves should therefore obtain water more easily than higher ones. Why, then, don't the lower leaves of a tree take all the available water, especially during times of drought, and thus cause the top to wither and dry?

Part of the answer has been known for some time: shaded leaves close their stomata (the tiny pores in the leaf blade through which water evaporates), reducing the rate of transpiration. But this still does not explain how a fully illuminated tree growing in the open can have vigorously functioning leaves at the top of its crown. The explanation appears to lie in the hydraulic architecture of trees, in the many pipelines that move water from the roots to the leaves.

As a painter and naturalist, Leonardo da Vinci was a keen observer of tree architecture. He wrote in his *Notebooks*:

> All the branches of a tree at every stage of its height, when put together, are equal in thickness to the trunk below them. All the branches of a water course at every stage of its course, if they are of equal rapidity, are equal to the body of the main stream. Every year when the boughs of a plant have made an end of maturing their growth, they will have made, when put together, a thickness equal to that of the main stem; and at every stage of its ramification you will find the thickness of the said main stem.

Leonardo's observation shows that tree dimensions at every point are sufficient to support the parts above. A small twig does not need to be bulky because it has to support only its own weight and that of a few leaves. A big branch, on the other hand, must be strong enough to bear the smaller branches above it and a large number of leaves. The wood of a tree is what provides the necessary strength. There is, however, more to tree construction than mere mechanical strength. As early as the seventeenth century, the Italian physician Marcellus Malpighi discovered that water moves from roots to leaves through the wood of trees. Thus, wood serves at least two major functions: a mechanical one, holding the tree upright, and a conducting one, providing the pipelines for the transport of water. In a tree stem, the water-conducting tissue, or xylem, is conspicuous, and we call it wood. But in a leaf, the xylem is part of the network of veins, and in a grass stem it is part of the vascular bundles.

Wherever it occurs on a tree, xylem tissue is made up of specialized cells. All plant cells produce a cellulosic wall around them while they grow. When a water-conducting cell has reached its final size, its wall thickens and hardens by incrustation with lignin, a complex polymer of aromatic substances. The living matter within the cell is then degraded and disappears, yielding the entire space bounded by the cell wall to water conduction. In conifers (needle-bearing trees such as pines, firs, and spruces), the conducting cells of the xylem are tracheids, spindle-shaped cells about 3mm long. In the more highly developed flowering plants, there are also water-conducting cells, known as vessel elements, which are more specialized. Relatively short, stacked end to end, and with their end walls dissolved, they form long capillaries, the vessels. Depending on the species of tree, the vessels may be less than an inch to several feet long. The ends taper out gradually, and successive vessels overlap. Each tracheid and each vessel are individual water-conducting compartments. On its way up the tree, water has to move repeatedly from one compartment to the next. In the case of a tall conifer, such as a redwood, passage of water from compartment to compartment has to be repeated tens of thousands of times along the stem.

The wall layers between neighboring compartments must allow this passage of water through the wall with relatively little flow resistance. At the same time they must be rigid enough to prevent collapse. Finally, if air has entered the xylem as the result of an injury, the walls must prevent the air from passing from one compartment to the next. To satisfy the first two of these three requirements—allowing the passage of water and maintaining rigidity—the common walls of neighboring conducting cells contain so-called bordered pits. The outermost wall layers of adjacent cells form the pit membrane, which water must cross. The thick inner-wall parts arch over the pit membranes, giving the cell strength while leaving much of the pit membrane accessible to water.

The third requirement—avoiding air embolism—is met by the capillarity of water. Normally, water is pulled up into the top of trees. This means that when the wood is injured, for example, by a beetle taking a bite, air is sucked into the damaged compartments, blocking the path of water movement. The longer the vessel, the more extensive the damage; if vessels are short, the damage is more confined. Air is prevented from passing from one vessel to the next by capillarity, the surface tension of water. Water molecules hold together and stick to the wet wall. Thus, considerable force is needed to push air through a wet pore. Most of us have observed this phenomenon in everyday life. When we prepare a cup of tea in too much of a hurry, the tea bag may get wet so quickly that the air in it does not have enough time to escape. Once the bag is wet, getting the air out is difficult, and the bag swims on top of the water in the teacup. If we dip the bag gently, however, giving the air time to escape through the

AMAZON

Jungles of Peru

Its sheer immensity, unrivaled diversity of fauna and flora, its beauty and tranquility make the Amazon a paradise for nature lovers.

EXPLORAMA LODGE

Located in the remote jungles of natures greatest spectacle – The Peruvian Amazon.

8 DAY EXPEDITION $998

All inclusive from Miami, with monthly departures.

INTERNATIONAL EXPEDITIONS INC.

Suite 104
1776 Independence Court
Birmingham, Al. 35216
(205) 870-5550

TOLL FREE
1-800-633-4734

Faucett
PERUVIAN AIRLINES

The Heritage Club Presents...

Five Ways to Recognize the Outstanding Value of Heritage Club Fine Books

Heirloom editions of the classics at only $13.50 each.

Thomas Hardy
THE RETURN OF THE NATIVE
Wood Engravings by Agnes Miller Parker
HERITAGE
JAMES FENIMORE COOPER
The Prairie
Illustrated by JOHN STEUART CURRY
Crime & Punishment
MELVILLE
MOBY DICK
HERITAGE
Main Street
BY SINCLAIR LEWIS
Illustrated by GRANT WOOD
Vanity Fair
TOLSTOY'S ANNA KARENINA
ILLUSTRATED BY BARNETT FREEDMAN
The Prince • NICCOLO MACHIAVELLI

At the convenient rate of one book per month, you can acquire an heirloom library of the world's greatest works of literature—the classic works of Twain, Poe, Hawthorne, Joyce, Tolstoy, Dante, Melville, Hardy...

For more than 40 years, The Heritage Club has offered a combination of advantages unmatched by any other classics library...and at an outstanding value.

1 Important Books of Exceptional Beauty and Elegance—Each a Work of Art and a Great Work of Literature.

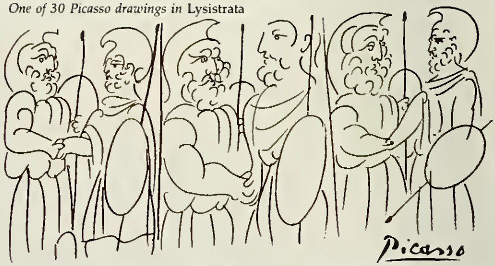
Throughout the world, Heritage Club books have come to be regarded as definitive editions of the world's greatest classics. The reason is that they are not only masterpieces of literature, but masterpieces of the book crafting art as well.

Over the years, The Heritage Club has orchestrated the talents of the world's most renowned artists, typographers, designers, binders and printers to produce books which rank among the finest and most beautiful in the world. Indeed, Heritage books have repeatedly captured top design awards and honors in Europe, Canada and the United States. They have even been exhibited at the Metropolitan Museum of Art.

When you display Heritage Club books on your shelves, you will enjoy deep feelings of pride. For these are fine books without compromise. Together, they form a beautiful and harmonious library that lends color, taste and dignity to your home.

2 Original Art Created Exclusively for Heritage Editions by the World's Greatest Artists... Picasso, Rockwell, Grant Wood and others.

One of 30 Picasso drawings in Lysistrata



The Heritage Club has, over the years, commissioned leading figures in the arts to illustrate each volume. Hence, Heritage editions abound with magnificent original works—all designed to increase the pleasure you and your family derive from each book.

It is a sheer delight, for example, while reading the immortal

Membership Application

THE HERITAGE CLUB

THE HERITAGE CLUB
47 Richards Avenue
Norwalk, Conn. 06857

No Payment Required
Simply mail this application.

YES! I want to join the Heritage Club and begin building my own personal library of the greatest books of all time.

Send me my FREE first volume. Assuming this book is satisfactory, I will then send **$13.50** (plus shipping and handling) to pay for the next volume in my Heritage library. I will continue to receive a volume per month for as long as I continue my membership. I understand that I may return any book within 30 days for a refund, and that either party may cancel this subscription at any time.

Further, if the first volume does not meet with my approval, I will return it and owe you nothing, and my membership will automatically be cancelled.

Mr.
Mrs.
Miss ______________________________

Address ______________________________

City ____________ State ________ Zip ________

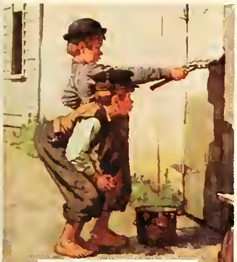
NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

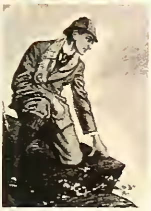
BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 743 NORWALK, CONN.

POSTAGE WILL BE PAID BY ADDRESSEE

THE HERITAGE CLUB
47 Richards Avenue
Norwalk, Conn. 06857

Norman Rockwell's Tom Sawyer





Sherlock Holmes as seen by Frederic Dorr Steele

Greek comedy, *Lysistrata*, to see the beautiful young women and courageous warriors of ancient Athens through the eyes of Pablo Picasso. The original works he created expressly for this book now hang in the Museum of Modern Art.

To illustrate *The Adventures of Tom Sawyer* and *Huckleberry Finn*, The Heritage Club, in 1936, commissioned exclusive works by Norman Rockwell. For who better than the warm and witty Rockwell could capture the mischief of Tom and Huck in their meanderings along Twain's beloved Mississippi.

If any publisher, including ourselves, tried to create such a magnificent classics library today, it would be utterly impossible at this price. We can do so only because we long ago acquired the rights to the priceless art of Picasso, Rockwell and others, before the peak of their fame.

3 Exclusive Introductions by the Twentieth Century's Leading Literary Figures.

A. A. Milne Thornton Wilder

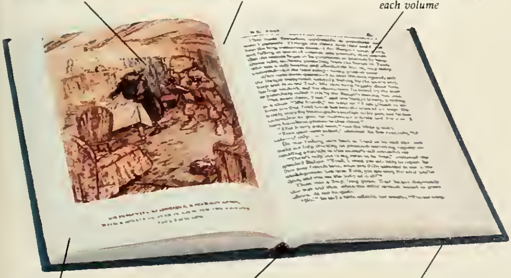
Sinclair Lewis Theodore Dreiser

For more than four decades, Heritage has also engaged the leading scholars and critics of our time to write introductions to every Heritage book. Giants of the literary world such as Sinclair Lewis, Thornton Wilder, A.A. Milne, Clifton Fadiman, Theodore Dreiser and others will give you priceless insights into each author's life and times, and the literary treasures a careful reader can unearth if he knows where to look. These masterful essays give you a heightened appreciation of each great book.

4 Heritage Club Books are Among the Best Made Books in the World.

Compare a Heritage edition to the usual book on your shelf and you will be astonished by the obvious differences.

You will note, for example, the covers are thick and sturdy. They won't curl or warp as do those of ordinary books. The papers are exceptionally heavy and meant to last 100 years without cracking or turning yellow. In binding, the pages are meticulously thread-sewn. Then, each book is reinforced to afford a double measure of strength and durability.



Flawless full-color reproductions of original works of art

Pages thread-sewn for extra strength in binding

Elegant type faces individually selected for each volume

Highest-quality, acid-neutral paper won't turn yellow

Traditional decorative headband—a hallmark of fine books

Heavyweight 88 point cover board resists curling with age

5 Heritage Club Books Come with the Many Extra Benefits of Club Membership...All for Only $13.50 a Book.

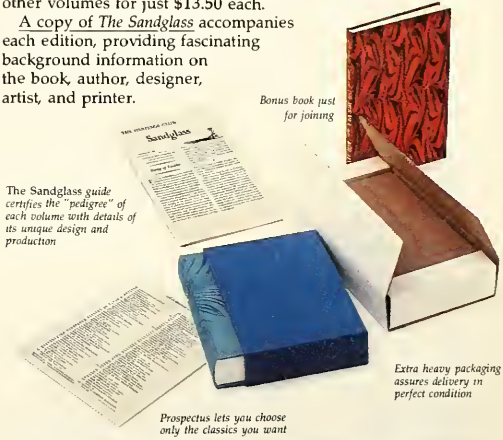
Heritage Club Membership is a refreshing alternative to other book clubs. Here's how:

As a member, you will receive, upon joining, a Prospectus of the Club's upcoming titles. You can freely choose only those you want to receive, which will then be sent at the rate of one per month. You may return any book within 30 days for a full refund, and you are at liberty to cancel your membership at any time.

You will also enjoy several delightful "extras"...

You'll receive a bonus book just for joining. This free bonus volume will speak far more persuasively than any magazine announcement can about the beauty and elegance of Heritage books. If for any reason you are not satisfied, simply return it. Your membership will be cancelled and you will owe nothing. If you are delighted with your bonus book, you may then receive other volumes for just $13.50 each.

A copy of *The Sandglass* accompanies each edition, providing fascinating background information on the book, author, designer, artist, and printer.



Bonus book just for joining

The Sandglass *guide certifies the "pedigree" of each volume with details of its unique design and production*

Extra heavy packaging assures delivery in perfect condition

Prospectus lets you choose only the classics you want

The Heritage Club's toll-free phone number lets you have any question or problem about membership handled quickly and personally.

Doubly-reinforced shipping cartons, designed for each book, assure that your books will arrive in mint condition.

Prompt Action Required

To accept this invitation, you need only complete the Membership Application and return it promptly. But, you must act now to take advantage of this bonus book offer and begin acquiring your own library of the world's greatest books in lasting heirloom editions.

Membership Application 163

THE HERITAGE CLUB
47 Richards Avenue
Norwalk, Conn. 06857

No Payment Required
Simply mail this application.

YES! I want to join the Heritage Club and begin building my own personal library of the greatest books of all time.

Send me my FREE first volume. Assuming this book is satisfactory, I will then send **$13.50** (plus shipping and handling) to pay for the next volume in my Heritage library. I will continue to receive a volume per month for as long as I continue my membership. I understand that I may return any book within 30 days for a refund, and that either party may cancel this subscription agreement at any time.

Further, if the first volume does not meet with my approval, I will return it and owe you nothing, and my membership will automatically be cancelled.

Mr.
Mrs.
Miss ____________________

Address ____________________

City ____________________

State ____________________ Zip ________

At Hertz, The Cost Of Winding Through Europe Has Gone Downhill.

FRANCE WAS $140 MAR. 1 NOW $131 798 Francs a week	ITALY WAS $143 MAR. 1 NOW $133 171,500 Lire a week
UNITED KINGDOM WAS $147 MAR. 1 NOW $138 76 Pounds a week	SPAIN WAS $119 MAR. 1 NOW $112 11,550 Pesetas a week
GERMANY WAS $112 MAR. 1 NOW $108 252 Marks a week	SWITZERLAND WAS $171 MAR. 1 NOW $158 308 Francs a week
BELGIUM WAS $119 MAR. 1 NOW $103 4,522 Francs a week	DENMARK WAS $136 MAR. 1 NOW $126 994 Kroner a week
LUXEMBOURG WAS $118 MAR. 1 NOW $102 4,480 Francs a week	NETHERLANDS WAS $122 MAR. 1 NOW $116 301 Guilders a week

Right now, your dollars can go a long way with the Hertz Affordable Europe program. That's because our rates are guaranteed in local European currency. And with the dollar's current strength abroad, the exchange rate is especially favorable.

The above prices reflect the weekly rate on a standard shift subcompact with no charge for mileage. (Drop-off charges have been eliminated within most countries to save you even more.) Reserve your car at least 14 days in advance and receive a confirmation form to be presented at the Hertz counter. When you pick up your car, pay with local currency or use your Hertz or other major credit card.

For full details on the program, see your travel consultant or call Hertz at 800-654-3001. The cost of your vacation could be the lesser for it.

Higher peak season rates may apply in some countries. Rental charges will be calculated at the rates shown in local European currency. Dollar equivalents may fluctuate with changing exchange rates. These rates are non-discountable. Local taxes, gasoline and any applicable drop-off charges are extra.

Hertz
AFFORDABLE EUROPE
HERTZ RENTS FORDS AND OTHER FINE CARS.

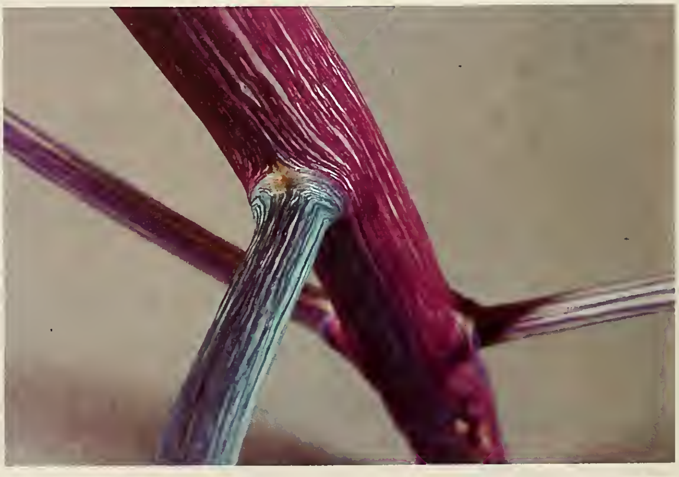
dry part of the bag, we avoid the problem. Years ago, before the days of plastic, children learning to swim often obtained a useful flotation device by wetting a pillowcase and then filling it with air, usually by swinging it around. Even today we occasionally read instructions on how to use a wet shirt to stay afloat in an emergency. In all cases, from cell wall to tea bag, the surface tension of water is what prevents air from penetrating the wet pores of the membrane. The smaller the pores in the wet membrane the greater the pressure necessary to push the air through.

All trees have resolved the problems of water transport in similar ways, but differences exist. In temperate regions, trees can be classified into three different groups according to their water-transport system. The first includes the conifers, which have only tracheids. Trees in the second and third groups have both tracheids and vessels. The second group consists of trees with what is called diffuse-porous wood (maple, birch, and apple trees, for example). The vessels of these trees are small in diameter (perhaps 75 micrometers) and scattered throughout the entire growth ring, hence the name diffuse-porous. The longest of these narrow vessels are one to two feet, but most are much shorter, and as many as 90 percent may be less than two inches. Narrow tracheids and vessels are not very efficient because conductance (the reciprocal value of resistance to flow) is proportional to the fourth power of the capillary diameter. These trees make up for their inefficient structure by producing a great many vessels and keeping them functional for many years. Conifers and diffuse-porous trees operate according to the principle of low efficiency but high safety.

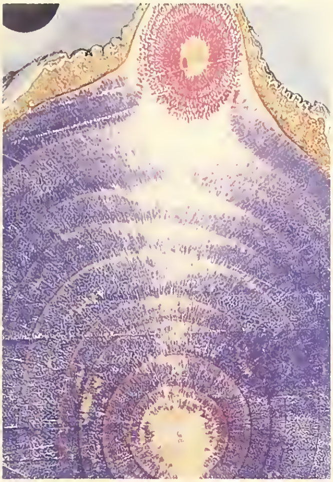
Trees in the third group, the ring-porous trees (such as oaks, ashes, elms, and chestnuts), are constructed according to the high-efficiency, high-risk principle. The vessels are some 300 micrometers in diameter, that is, about four times as wide as those of diffuse-porous trees. If they are four times as wide, each can carry 4^4, or 256, times as much water. These wide vessels are also very long: some of them are as long as the tree is tall, others are shorter but still much longer than the longest vessels of the diffuse-porous trees. This efficient water-conducting system has the disadvantage of high risk. Indeed, every winter the vast majority of these large vessels are embolized by air bubbles (air is soluble in water but not in ice). In the early spring, therefore, these trees must produce new vessels before the leaves appear. Oaks, for example, are notoriously late to open their buds.

The wide and long vessels of ring-porous trees are so efficient, however, that

Water moves from roots to leaves through the wood of trees. Ring-porous trees, like the ash from which this piece was cut, make new water-conducting vessels every spring. The vessels of such trees are concentrated in a narrow band at the beginning of the year's growth. Dyes of different colors can be injected into the vessels, and when the bark is peeled, the routes traveled by the various dyes become visible, revealing which part of the stem serves a particular branch.



Julian Hadley and Martin H. Zimmermann



The water-conducting vessels in diffuse-porous trees, such as birch and maple, are scattered throughout the growth ring. This section of birch wood shows blue dye, which was injected into the stem, and red dye, which was injected into one of the branches. Nonconducting wood shows up white. The vessels in this part of the wood may have been damaged as the branch swayed in a rough wind.

one spring's production is enough to supply the crown with water during the summer. Made in the early spring, these large vessels are all located at the beginning of the season's growth layer, thus forming a conspicuous ring on a transverse section of the stem, as the name ring-porous suggests. Most of the water conduction takes place in the most recently produced growth ring, just underneath the bark. This superficial location is another factor that makes water transport particularly vulnerable in ring-porous trees, and some of the most deadly tree diseases, such as the chestnut blight and the Dutch elm disease, accomplish their devastation by interrupting water conduction.

The greater safety of water conduction in a diffuse-porous tree is also evident in the greater number of functional vessels present in them. If the vessels in a diffuse-porous tree are four times narrower than in a ring-porous tree, 256 times as many vessels are needed per transverse-sectional stem area. The narrow vessels are also

FREE TRIAL ORDER FORM

CLASSIC GENUINE LEATHER PENNY LOAFERS ONLY $19.85 A PAIR

BLAIR™
MENSWEAR FROM NEW PROCESS COMPANY SINCE 1910

WALK TEST YOURS FREE FOR ONE WEEK • 100% full-grain leather uppers • supple leather hugs your foot for ultimate comfort • luxurious leather breathes • durable leather lasts for years • cushioned heels • full inner lining • built-in steel shanks • Blair shoes are guaranteed for a full year's normal wear or a *new pair FREE*

YES! Please save me time and money. Rush my genuine leather Penny Loafers right to my door for a week's FREE TRIAL. After one week I'll send only $19.85, plus postage and handling, or return them at my expense and owe you nothing.

If I send payment with this order, Blair pays ALL postage and handling costs. My money instantly refunded if I'm not pleased.

8BL-B

☐ Mr
☐ Mrs. ____________________
☐ Miss

____
Address Apt #

____
City State Zip

( )____________________
Home Phone No. Credit Orders Subject to Approval

Mail your order form today to:
BLAIR, NPC MENSWEAR, WARREN, PA 16366
(Offer Good Only in Continental U.S.A.)

TO ORDER, FILL IN YOUR SIZE AND CHECK COLOR.

DESCRIPTION	QTY	SIZE	WIDTH	PRICE
Penny Loafers 2878	1 pair			$19 85
🟥 Classic Cordovan 31		■ Rich Black 32		

AVAILABLE SIZES: 7, 7½, 8, 8½, 9, 9½, 10, 10½, 11, 12, 13
WIDTHS: Narrow, Medium, Wide

Where in the world can you save money on a tropical vacation?

Now a vacation in peaceful Costa Rica is a better value because your dollar exchanges for twice as much as last year. Get away to our unspoiled beauty and year-round spring climate without blowing a bundle. For information write the Costa Rica Tourist Board, 200 S.E. First St., Miami, FL or call **800-327-7700**, **(800-432-7502** in FL), the airline that's happy to please you...LACSA.

Lacsa
The Airline of Costa Rica

COSTA RICA
we have so much to share

about 25 times shorter, which means that for every large vessel of the ring-porous tree, the diffuse-porous tree must have 6,400 vessels. A single bite of a beetle into a single vessel is therefore 6,400 times more serious in the ring-porous tree.

The arrangement of vessels can be demonstrated with motion-picture film assembled frame by frame from series of individual transverse sections of wood, a technique P. B. Tomlinson and I developed. Analyses of such films make possible the reconstruction of three-dimensional vessel arrangement. They show that vessels always end in pairs or clusters and that they are arrayed in neat parallel rows. Vessels crisscross within the growth ring, forming a complex network. If a radial hole is drilled into a tree and a dye injected into it, the dye spreads out within the growth ring as it ascends the stem. This is a considerable safety feature of tree construction: water from each root reaches many branches, and each branch is supplied by many roots.

Understanding how a tree safely transports water upward, however, still does not fully explain the hydraulic architecture of trees. In Leonardo's concept of tree construction, each chain of vessels is like a little pipe leading from the roots all the way up to every leaf. Bundled together, these little pipes make twigs, branches, and finally the stem. This concept is sometimes referred to as the pipe model. Is the model correct?

During the 1920s the German botanist Bruno Huber introduced a useful way of looking at tree construction by relating the transverse-sectional area of a twig, branch, or stem to the quantity of leaves supplied via that transverse section. He found that Leonardo's principle—based on observations of visible tree dimensions—held quite well. In addition, he discovered that the leader (the top shoot) of the little fir trees he studied seemed to be favored in terms of water conduction. The area of transverse-sectional xylem available to supply a gram (fresh weight) of leaves increases sharply, from 0.5mm^2 in most parts of the tree to 2mm^2 at the very top.

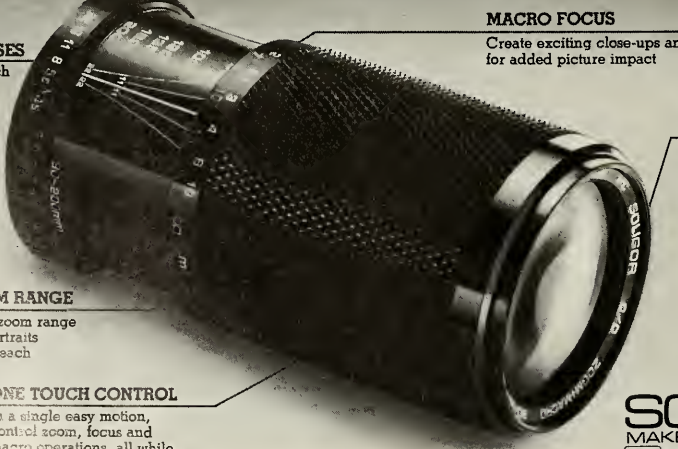
Huber's measurements, however, do not provide much information about hydraulic properties for at least two reasons. First, older wood may have stopped conducting. Second, the efficiency of water conduction is greatly dependent on the diameters of the vessels. Therefore, for more precise information about the hydraulic architecture of a tree, conductance must be measured.

Conductance per transverse-sectional area, which is known as conductivity, describes the property of wood as a water conductor. Conductivity is defined as the amount of water that flows through a piece of wood under specified conditions: flow must be expressed per unit time (for example, twice as much water flows through a stem within twice as long a time), per transverse-sectional area of the xylem (twice as much flows through twice the area), and per applied pressure gradient (twice as much flows through if water is pushed through with twice the force).

When I measure the conductance of twigs, branches, or stems in the laboratory, my calculations are based, not on the transverse-sectional area, but on the leaf quantity that is supplied by the twig, branch, or stem measured. Measurements of this leaf-specific conductivity (LSC) are made by cutting a tree in the forest, labeling those points in the stem, branches, and twigs to be measured, and weighing all leaves above these points. The labeled sections are then cut out, and LSC measurements of them are made in the laboratory. If the pipe model were correct, LSC should be the same wherever the measurement is taken. For example, the rate of flow of water through the main stem is very high, but divided by the weight of the entire leaf mass that is supplied by the

GET BETTER SOON!

Get better pictures with your SLR camera and our Soligor 80-200mm zoom lens . . . better because you can zoom to compose the shots you want . . . better because those clear, sharp images you see are the result of nearly 30 years of Soligor lens technology and quality. The lens says it, the results say it, and millions of satisfied customers have been saying it for years. See the Soligor 80-200mm One Touch Zoom + Macro at your dealer and get better pictures soon. Or, write for full information.



CUSTOM DESIGNED LENSES
There's one for each popular camera brand: Canon, Minolta, Nikon, Olympus, Pentax and others

MACRO FOCUS
Create exciting close-ups and detail shots for added picture impact

STATE-OF-THE-ART COMPUTER DESIGN
Rare earth glass, precision engineered 12-element construction, multicoated; all the finest quality features you'd expect of Soligor, plus an unbeatable price!

80-200MM ZOOM RANGE
The most popular zoom range of all, covering portraits to long telephoto reach

ONE TOUCH CONTROL
In a single easy motion, control zoom, focus and macro operations, all while keeping your eye on the subject

SOLIGOR®
MAKES THE DIFFERENCE
AIC Photo, Inc. Carle Place, N.Y. 11514
In Canada Kingsway Film Equipment., Ltd. Ontario

stem, the resultant LSC value should be the same as that of a branch with lesser conductivity divided by the weight of the leaves supplied by that branch. This turns out, however, not to be the case. LSC is very different in different parts of the tree. In general, it is about half as great in lateral branches as in the stem; it is even less in smaller twigs, and still less in leaf petioles. Junctions where a branch comes off the stem or a twig comes off a branch often represent hydraulic bottlenecks, where resistance to flow is particularly high.

This construction is a superb functional adaptation for tree survival. The path of water movement to the top leaves is facilitated by the very high conductivity of the stem, while the path to the lower lateral leaves is made more difficult. This prevents the lower leaves from taking all the water at the expense of those important ones at the top. But there is more to it than this, and a look at the mechanism of water conduction in a little more detail reveals the full implications of the design.

Flow of water is always along a pressure gradient, from higher to lower pressure. Xylem pressures are not normally positive, and except under rare conditions, such as in sugar maples late in winter, water does not flow out when wood is cut. During transpiration, water is pulled up into the crown. This means that the water columns in the xylem are under less-than-atmospheric pressure, and pressures are often negative.

The concept of negative pressures in liquids is difficult to understand. The liquid of a cup of tea is under one atmosphere pressure, exerted by the weight of the atmosphere. In outer space, pressure is zero, producing a vacuum. Liquids normally evaporate when exposed to a vacuum, but a liquid enclosed in a small compartment with no bubbles may not evaporate. It may even be possible to subject the liquid to negative pressures, or tensions, without evaporation. In that case the liquid behaves like a flexible solid. This is what happens in trees. The tensile strength of water is limited, however. If, under conditions of drought, stresses become too great, the water columns may break. A break is less serious if it happens in only a small part of the xylem, demonstrating once again the advantage of small vessels.

When pressures are negative, water flows from an area of negative pressure to an area where pressure is even more negative. The greater the flow resistance (the lower the LSC) of a path, the steeper the pressure gradient must be to transport the same amount of water. Because of the increasing flow resistance to twigs and leaves, pressures in these peripheral parts must be considerably lower than in the stem. Leaves always experience the lowest pressures, and in case of drought, water columns will break there first. If the drought is severe, some columns may even break in twigs and branches. This further increases flow resistance, and eventually entire branches may die from lack of water caused by vapor blocks in their xylem. The stem, the most important and largest investment of the tree, remains functional. The importance of maintaining the functional integrity of the stem is particularly apparent in palms. Unlike oaks and other dicotyledons that grow in diameter, these monocotyledonous trees have no cambium in the stem to produce new wood.

Hydraulic architecture may also have been a very powerful evolutionary factor in trees. One of the conspicuous characteristics of the earliest trees, which lived some 300 million years ago, was dichotomous branching. This construction—in which an axis of a plant divides into two equal branches—does appear to conform to the pipe model. Some small, primitive herbaceous plants still branch in this manner, but the form is almost extinct in trees. Perhaps, as P. B. Tomlinson suggested, the dichotomous-branching tree form was simply unable to compete with the hydraulically superior construction of modern trees. □

KAHLÚA® & Ice Cream
yumm.
IMPORTED FROM SUNNY MEXICO
KAHLÚA
Licor de Café
COFFEE LIQUEUR
PRODUCT OF MEXICO

Yumm's the word:
for an ounce of Kahlúa
over your favorite
ice cream. If you like,
add shaved chocolate.
And send for our Kahlúa
recipe book. It's free.

Kahlúa Coffee Liqueur
from Sunny Mexico
53 Proof. Maidstone
Wine & Spirits Inc.
116 N. Robertson Blvd.
Los Angeles, CA 90048.

The Oddball Human Male

Females are larger than males in a majority of animal species

by Stephen Jay Gould

Alfred, Lord Tennyson, never known for egalitarian perspectives, had this to say about the relative merit of the sexes:

> Woman is the lesser man, and all
> thy passions, matched with mine,
> Are as moonlight unto sunlight, and
> as water unto wine.

The couplet may not represent Tennyson's considered view, since the protagonist of "Locksley Hall" had lost his love to another and speaks these words during a grand poetic fit of sour grapes. Still, the literal reading—that women are smaller than men—would be accepted by most of us as a general fact of nature, not as a sexist trap. And most of us would therefore be wrong.

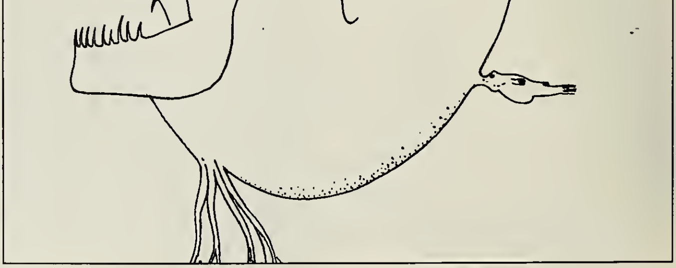
Human males are, of course, generally larger than human females, and most familiar mammals follow the same pattern. Yet females are larger than males in a majority of animal species—and probably a large majority at that. For starters, most animal species are insects and female insects usually exceed their males in size. Why are males generally smaller?

One amusing suggestion was proposed in all seriousness just 100 years ago (I learned about it from the "50 and 100 Years Ago" column in this January's *Scientific American*). A certain M.G. Delaunay argued that human races might be ranked by the relative social position of females. Inferior races suffered under female supremacy, males dominated in superior races, while equality of sexes marked races of middle rank. As leading support for his peculiar thesis, Delaunay argued that females are larger than males in "lower" animals and smaller in "higher" creatures. Thus, the greater number of species with larger females posed no threat to a general notion of male superiority. After all, many serve and few rule.

Delaunay's argument is almost too precious to disturb with refutation, but it's probably worth mentioning that the paradigm case of a "higher" group with larger males—the mammals—is shakier than most people think (see the fine review by Katherine Ralls, "Mammals in Which Females Are Larger than Males," *Quarterly Review of Biology*, vol. 51, 1976, p. 245). Males are larger in a majority of mammalian species, of course, but Ralls found a surprising number of species with larger females, spread widely throughout the range of mammalian diversity. Twelve of 20 orders and 20 of 122 families contain species with larger females. In some important groups, larger females are the rule: rabbits and hares, a family of bats, three families of baleen whales, a major group of seals, and two tribes of antelopes. Ralls further reminds us that since blue whales are the largest animals that have ever lived, and since females surpass males in baleen whales, the largest individual animal of all time is undoubtedly a female. The largest reliably measured whale was 93.5 feet long and a female.

The sporadic distribution of larger females within the taxonomic range of mammals illustrates the most important general conclusion we can reach about the relative size of sexes: the observed pattern does not suggest any general or overarching trend associating predominance of either sex with anatomical complexity, geological age, or supposed evolutionary stage. Rather, the relative size of sexes seems to reflect an evolved strategy for each particular circumstance—an affirmation of Darwin's vision that evolution is primarily the story of adaptation to local environments. In this perspective, we must anticipate the usual pattern of larger females. Females, as producers of eggs, brood their young far more often than males do. (Such male tenders as sea horses and various mouth-brooding fishes must receive eggs directly from a female or actively pick up eggs after a female discharges them.) Even in species that furnish no parental care, eggs must be provided with nutriment, while sperm is little more than naked DNA with a delivery system. Larger eggs require more room and a bigger body to produce them.

If females provide the essential nutriment for embryonic or larval growth, we might ask why males exist at all. Why bother with sex if one parent can supply the essential provisioning? The answer to



AMNH

A male anglerfish (lower right), about one-and-a-half inches long, embeds itself into a ten-inch female of the same species.

First, take care of the necessities.
JVC
HIGH FIDELITY DIVISION
US JVC CORP.

The Institute of Jazz Studies is proud to announce its Official Archive Collection

THE GREATEST JAZZ RECORDINGS OF ALL TIME

Unprecedented in recording history — the complete and definitive collection of great jazz performances

"Now it's all together . . . all the best of jazz, at long last, in one place. With all the joy, the sorrow, the vitality that makes jazz great. It gives me a tremendous feeling to know this collection is being done, and I'm delighted to be a part of it."

—Dave Brubeck

SUBSCRIPTION APPLICATION

THE GREATEST JAZZ RECORDINGS OF ALL TIME

Please mail by July 31, 1982.

The Franklin Mint Record Society
Franklin Center, Pennsylvania 19091

Please enter my subscription for *The Greatest Jazz Recordings of All Time,* consisting of 100 proof-quality records in custom-designed library albums, at the issue price of $10.75* per record plus $.95 for packaging, shipping and handling.

No payment is required now. Every other month, I will receive a 4-record album. And I will be billed for each album in two equal monthly installments, beginning when my first album is ready to be sent. I understand that I may discontinue my subscription at any time upon thirty days' notice.

**Plus my state sales tax.*

( ) Check here to receive the collection on standard Dolby† encoded tape cassettes. Same subscription plan, $1. extra per cassette.

†Trademark of Dolby Laboratories.

Signature______________________________
ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE.

Mr./Mrs./Miss______________________________
PLEASE PRINT CLEARLY

Address______________________________

City, State, Zip______________________________

© 1982 FMRS A 4

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

EV

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 1 FRANKLIN CENTER, PENNSYLVANIA

POSTAGE WILL BE PAID BY ADDRESSEE

The Franklin Mint Record Society
Franklin Center, Pennsylvania 19063

B

A collection that only the Institute of Jazz Studies could assemble:

- ☐ *The best of over 60,000 records from the Institute's archives and the vaults of every great jazz label.*
- ☐ *Including rare out-of-issue pressings, unreleased recordings – and studio "takes" just recently discovered.*
- ☐ *The first and only collection to tell the entire jazz story.*

FOR THE FIRST TIME EVER, the greatest recorded performances in the history of jazz will be brought together in a single, definitive record collection.

This unprecedented collection is being issued by the Institute of Jazz Studies, home of the world's largest archive of original jazz recordings. It will include the most important recordings of every major jazz artist who ever lived. And it will span all periods ... all labels ... all the great styles that have made jazz the most inventive and exciting music of our century.

From the world's largest jazz archive

The Greatest Jazz Recordings of All Time is the culmination of years of work carried on at the Institute's headquarters at Rutgers University—by a staff of authorities unique in all the world.

As they set about making their selections, no resource was denied them. They considered countless recordings, beginning with the Institute's own archive of more than 60,000 records. In addition, they received the support of all the great jazz labels, whose vaults hold the master recordings essential for this collection.

The most comprehensive collection ever assembled

As a result, this will be the first collection to capture the all-time best of jazz, as it flourished in each generation. The greatest music from the *golden age*—the dazzling trumpet solos of Louis Armstrong, the biting elegance of Bix Beiderbecke's cornet, and the vital, vibrant piano styles of Fats Waller.

From the era of *swing*—the innovative bands of Benny Goodman, Count Basie, Gene Krupa; the incomparable Duke Ellington; singers Billie Holiday, Bing Crosby; guitarist Django Reinhardt in his "Hot Club of France" recordings.

The best of *bop* and *cool jazz*—with alto sax artists ranging from the fiery Charlie Parker to the impeccably graceful Paul Desmond ... trumpeters Dizzy Gillespie and Miles Davis ... the Oscar Peterson Trio ... Milt Jackson, with the Modern Jazz Quartet.

And the great musicians who are bringing jazz to more people than ever *today*—including George Benson, Herbie Hancock and Chick Corea.

A collection you could never assemble in any other way

This is a collection that could not be duplicated by any individual. For it draws upon a wealth of rare recordings which belong to the Jazz Institute—including important material just uncovered in the last few years.

Some of these recordings, such as Teddy Wilson's solo piano version of 'Somebody Loves Me,' have actually *never* been issued before. Others have been unavailable for decades—such as Art Tatum's 'Chloe.' And among the most fascinating of all are the previously unreleased studio "takes" of well-known numbers like 'Benny's Bugle' by Charlie Christian and 'I Can't Get Started' by Bunny Berigan.

And all the *classics and hits* of jazz will be here. Unforgettable performances of 'St. James Infirmary' by Jack Teagarden, 'China Boy' by Eddie Condon, and 'Stardust' by Lionel Hampton.

The superior sound of proof-quality records

The sound quality of each record will be a revelation. For every vintage recording will first undergo a painstaking restoration. Each will be electronically "cleaned," groove by groove ... bringing you closer to the actual performance than was previously possible.

Furthermore, the Institute of Jazz Studies has appointed The Franklin Mint Record Society, one of America's leading producers of high-quality records, to press the records for this collection. And they will use a special vinyl compound containing its own anti-static element. In addition, each record will be pressed in an atmosphere controlled "clean room." The result—a pressing of superior fidelity that is also more durable and resistant to dust. A record of true *proof-quality*.

The records will be issued in hardbound albums. Each album will hold a set of four 12" long-playing records. And each will present a specially conceived *program of selections,* which brings together related performances in a way unique to this collection. Accompanying each album will be an expert commentary, written under the supervision of Institute Director Dan Morgenstern.

Available exclusively by subscription

Throughout the world today, people are rediscovering jazz: realizing anew what a vital musical form it is. If you have a love for jazz ... whether you follow it avidly or remember it with nostalgia ... this is an opportunity not to be missed.

THE GREATEST
JAZZ RECORDINGS
OF ALL TIME

The collection is available *only* by subscription. Albums will be shipped at the rate of one every other month, and the price of $10.75 for each proof-quality record will be *guaranteed* throughout your subscription period.

To subscribe now, mail the accompanying application to The Franklin Mint Record Society, Franklin Center, Pennsylvania 19091, by July 31, 1982.

© 1982 FMRS

this old dilemma seems to lie in the nature of Darwin's world. If natural selection propels evolution by preserving favored variants from a spectrum randomly distributed about an average value, then an absence of variation derails the process—for natural selection makes nothing directly and can only choose among alternatives presented. If all offspring were the xeroxed copies of a single parent, they would present no genetic variation (except for rare new mutations) and selection could not operate effectively. Sex generates an enormous array of variation by mixing the genetic material of two creatures in each offspring. If only for this reason, we shall have males to kick around for some time.

But if the biological function of males does not extend beyond the contribution of some essentially naked DNA, why bother to put so much effort into making them? Why should they in most cases be almost as big as females, endowed with complex organs, and quite capable of an independent life? Why should industrious bees continue to make the large and largely useless male creatures appropriately known as drones?

These questions would be difficult to answer if evolution worked for the good of species or larger groups. But the theory of natural selection holds that evolution is fundamentally a struggle among individual organisms to pass more of their genes into future generations. Since males are essential (as argued above), they become evolutionary agents in their own right; they are not designed for the benefit of their species. As independent agents, they join the struggle in their own ways—and these ways sometimes favor a larger size. In many groups, males fight (literally) for access to females, and heavyweights often have an edge. In more complex creatures, social life may emerge and become ever more elaborate. Such complexity may require the presence and active involvement of more than one parent, and males gain a biological role transcending mere stud service.

But what of ecological situations that neither favor battle nor require parental care? After all, Tennyson's most famous biological line—his description of Darwin's world as "Nature, red in tooth and claw"—does not apply in all, or most, cases. Darwin's "struggle for existence" is a metaphor and need not imply active combat. The struggle for genetic representation in the next generation can be made in a variety of ways. One common strategy mimics the motto of rigged elections: vote early and vote often (but substitute "fornicate" for "vote"). Males who follow this

When most people think of oil, they usually think of Arabs or Texans. Well, now they can think of West Africans too. Nearly a dozen West African countries have developed oil and gas resources.

Handshaking is an important social grace, so do remember to shake hands whenever you're being introduced.

Say Africa and some people picture mud huts and watering holes. Well, be assured that some of the finest hotels in the world are in West Africa. Air-conditioned rooms, swimming pools, friendly bars and fine restaurants.

Abidjan, Ivory Coast is the "Manhattan of Africa". It has real skyscrapers. The Hotel Ivoire is like a glass-enclosed Rockefeller Center.

Drums of oil & drum talk.

West Africa is the part of Africa that's closest to the U.S.A. Just seven luxurious hours away on Air Afrique.

Drum talk–or "bush telegraph" as it is commonly called–is really a secret language that only the initiated can understand. Wanna learn?

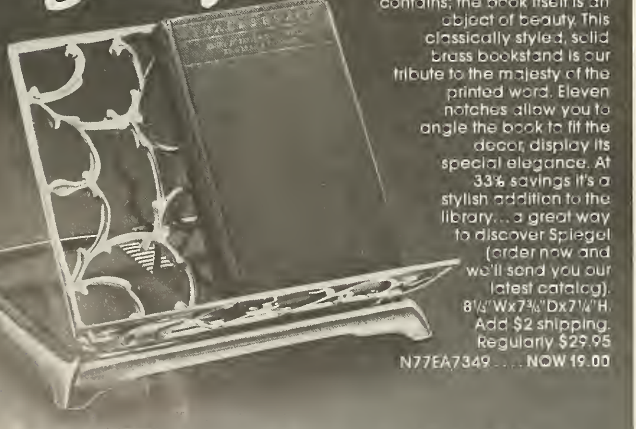
Why wait? Isn't it time you discovered West Africa? Just call your Travel Agent or your nearest Air Afrique/Air France office today. Hurry.

AIR AFRIQUE
Africa begins with Air Afrique.
And it's just seven hours to the New Sun...
West Africa.

DISCOVER
Spiegel

The brass bookstand... for the true bibliophile. A great book is more than the ideas it contains; the book itself is an object of beauty. This classically styled, solid brass bookstand is our tribute to the majesty of the printed word. Eleven notches allow you to angle the book to fit the decor, display its special elegance. At 33⅓% savings it's a stylish addition to the library... a great way to discover Spiegel (order now and we'll send you our latest catalog). 8¼"Wx7¾"Dx7¼"H. Add $2 shipping. Regularly $29.95
N77EA7349.... NOW 19.00

Call us toll free and charge to your major credit card: 1-800-345-4500. Or send check to Spiegel, P.O. Box 7019, Chicago, IL 60680. Add sales tax in CA, IL, PA. If you don't wish to order, but want our catalog, send $3 (applicable to your first purchase) to Dept. 271, Spiegel, P.O. Box 6340, Chicago, IL 60680.



tactic have no evolutionary rationale for large size and complexity beyond what they need to locate a female as quickly as possible and to stick around. In such cases, we might expect to find males in their minimal state, a state that might have become quite general if evolution worked for the good of species—a small device dedicated to the delivery of sperm. Nature, ever obliging, has provided us with some examples of what, but for the grace of natural selection, might have been my fate.

Consider a species so thinly spread over such a broad area that males will rarely meet at the site of a female. Suppose also that females, as adults, move very little if at all: they may be attached to the substrate, as in barnacles; they may live parasitically, within another creature; or they may feed by waiting and luring rather than by pursuit. And suppose finally that the surrounding medium can easily move small creatures about—as in the sea, with its currents and high density (see M. Ghiselin, *The Economy of Nature and the Evolution of Sex*, chapter 7, University of California Press, 1974, for a discussion of this phenomenon). Since males have little impetus for literal battle, since they must find the stationary female, and since the medium in which they live can provide (or substantially aid) their transport, why be large? Why not find a female fast when still quite small and young and then hang on as a simple source of sperm? Why work and feed, and grow large and complex? Why not exploit the feeding female? All her offspring will still be 50 percent you.

Indeed, this strategy is quite common, although little appreciated, among marine invertebrates that either live at great depth (where food is scarce and populations very thinly spread), or place themselves in widely dispersed spots that are hard to locate (as in many parasites). Here we often encounter that ultimate in the expression of nature's more common tendency—females larger than males. The males become dwarfs, often less than one-tenth the length of females, and evolve a body suited primarily for finding females—a sperm delivery system of sorts.

A species of *Enteroxenos*, for example, a molluskan parasite that lives inside the gut of sea cucumbers (echinoderms related to sea urchins and starfishes), was originally described as a hermaphrodite, with both male and female organs. But J. Lutzen of the University of Copenhagen recently found that the male "organ" is actually the degenerated product of a separate dwarf male organism that found the parasitic female and attached permanently to her. The female *Enteroxenos* fastens herself to the sea cucumber's

INDIA.
WHERE THE WORD IS WORTH A THOUSAND PICTURES.

Visit the Taj.

Our people are warm and friendly

Make a houseboat your hotel.

Stay in a modern hotel.

The last of the Bengal tigers

Live in a Maharajah's lake palace

Ancient temples.
Peacocks roosting in mango trees.
Colorful bazaars bustling with people.
India will fill your life with pictures. Pictures that will last forever.
In India you can trek on rugged mountain trails, do yoga on a fabulous beach, meet holy men.
You can stay in great hotels, or float in your own houseboat.
Whatever you'd like, we have. Wildlife. Art, music and dance. Enchanting festivals and fairs.
And more.
Come visit us. There are lots of tours to our country. Your travel agent will tell you about them.
Or send us the coupon and we will.

UNBELIEVABLE
INDIA

Please send me information on Unbelievable India. NH-7

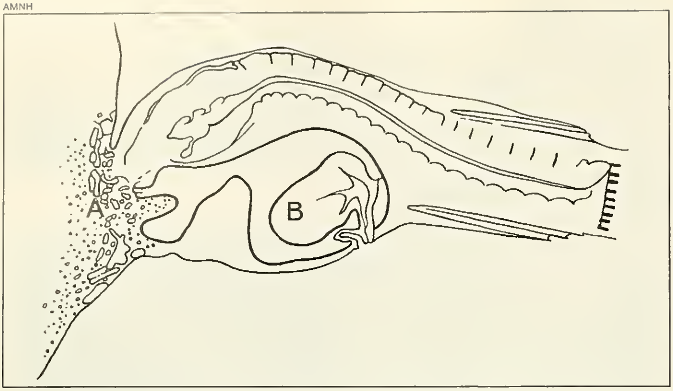
Name

Address

City

State, Zip

GOVERNMENT OF INDIA TOURIST OFFICE
30 ROCKEFELLER PLAZA, NEW YORK, N.Y. 10112 (212) 586-4901, 3550 WILSHIRE BLVD., LOS ANGELES, CA 90010 (213) 380-8855
230 N. MICHIGAN AVE., CHICAGO, IL 60601 (312) 236-6899, POST BOX 342 T.D. CENTRE, TORONTO, CANADA (416) 362-3188,
MIAMI, FLA (305) 944-7039, DALLAS, TEXAS (214) 234-2233; SAN FRANCISCO, CA. (415) 564-2973



AMNH

A simplified cross section shows a male anglerfish attached to a female. The two fish share tissue (A) and the male's testis (B) has become enlarged.

esophagus by a small ciliated tube. The dwarf male finds the tube, enters the female's body, attaches to it in a particular place, and then loses virtually all its structures except, of course, for the testes. After a male enters, the female breaks its tubular connection with the sea cucumber's esophagus, thereby obliterating the pathway of entrance for any future males. (A strict Darwinian—I am not one—would predict that the male has evolved some device to break or cause the female to break this tubular connection, thereby excluding all subsequent males and assuring that it will father all the female's offspring. But no evidence yet exists for or against this hypothesis.)

As long as such an uncomfortable phenomenon resides with unfamiliar and "lowly" invertebrates, male supremecists who seek pseudosupport from nature may not be greatly disturbed. But I am delighted to report that it is also prominently displayed by one group of eminently suited vertebrates—deep-sea anglerfishes of the Ceratioidei (a large group with 11 families and nearly 100 species).

Ceratioid anglerfishes have all the prerequisites for the evolution of dwarf males as sperm delivery systems. They live at depth in the open ocean, mostly from 3,000 to 10,000 feet below the surface, where food is scarce and populations sparse. Females have detached the first dorsal fin ray and moved it forward over their capacious mouth. They dangle a lure at the tip of this spine and literally fish with it. They jiggle and wave the lure while floating, otherwise immobile, in the midst of the sea. The related shallower-water and bottom-dwelling anglerfishes often evolve elaborate mimetic structures for their lures—bits of tissue that resemble worms or even a decoy fish (see my column of January 1979). The ceratioids live well below the depth that light can penetrate sea water. Their world is one of total ambient darkness, and they must therefore provide the light of attraction themselves. Their lures glow with a luminescence supplied by light glands—a death trap for prey and, perhaps, a beacon for dwarf males.

In 1922, B. Saemundsson, an Icelandic fisheries biologist, dredged a female *Ceratias holbolli*, 26.16 inches in length. To his surprise, he found two small anglerfish, only 2.03 and 2.1 inches long, attached to the female's skin. He assumed, naturally, that they were juveniles, but he was puzzled by their degenerate form: "At first sight," he wrote, "I thought these young ones were pieces of skin torn off and loose." Another oddity puzzled him even more: these small fish were so firmly attached that their lips had grown together about a wad of female tissue projecting well into their mouth and down their throat. Saemundsson could find no other language for his description but an obviously inappropriate mammalian analogy: "The lips are grown together and are attached to a soft papilla or 'teat' protruding, so far as I can see, from the belly of the mother."

Three years later, the great British ichthyologist C. Tate Regan, then keeper of fishes and later boss of the British Museum (Natural History), solved Saemundsson's dilemma. The "young ones" were not juveniles, but permanently attached, sexually mature dwarf males. As Regan studied the details of attachment between male and female, he discovered the astounding fact that has ever since been celebrated as one of the greatest oddities in natural history: "At the junction of the male and the female fish there is a complete blending . . . their vascular systems are continuous." In other words, the male has ceased to function as an independent organism. It no longer feeds, for its mouth is fused with the female's outer skin. The vascular systems of male and female have united, and the tiny male is entirely dependent upon the female's blood for nutrition. Of a second species with similar habits, Regan writes: "It is impossible to say where one fish begins and the other ends." The male has become a sexual appendage of the female, a kind of incorporated penis. (Both popular and technical literature often refer to the fused male as a "parasite." But I demur. Parasites live at the expense of their host. Fused males depend upon females for nutrition, but they supply in return that most precious of biological gifts—access to the next generation and a chance for evolutionary continuity.)

The extent of male submergence into the female of these anglerfish has been exaggerated in most popular accounts. Although attached males surrender their vascular independence and lose or reduce a set of organs no longer needed (eyes, for example), they remain more than a simple penis. Their own heart must still pump the blood now supplied by females, and they continue to breathe with their gills and remove wastes with their kidneys. Of one firmly attached male, Regan writes:

> The male fish, although to a great extent merely an appendage of the female, and entirely dependent on her for nutrition, yet retains a certain autonomy. He is probably capable, by movements of the tail and fins, of changing his position to some extent. He breathes, he may have functional kidneys, and he removes from the blood certain products of his own metabolism and keeps them as pigment. . . . But so perfect and complete is the union of husband and wife that one may almost be sure that their genital glands ripen simultaneously, and it is perhaps not too fanciful to think that the female may possibly be able to control the seminal discharge of the male and to ensure that it takes place at the right time for the fertilization of her eggs.

Nonetheless, however autonomous, the males have not honed themselves to Darwinian optimality, for they have evolved no mechanism for excluding other males from subsequent attachment. Several males are often embedded into a single female.

(While criticizing the exaggeration of some popular accounts, allow me a tangential excursion to express a pet peeve. I relied upon primary, technical literature

CUSTOMER INFORMATION FROM GENERAL MOTORS

HOW TO SAVE YOUR LIFE AND THE ONE NEXT TO YOU

OVERCOMING YOUR PSYCHOLOGICAL RESISTANCE TO SEAT BELTS MAY BE THE KEY.

The facts are startling. Experts estimate that almost half of all automobile occupant fatalities and many serious injuries might have been avoided if the people had been wearing seat belts. That's because most injuries occur when the car stops abruptly and the occupants are thrown against the car's interior or out of the car. Belts reduce this risk.

Many people say they know the facts, but they still don't wear belts. Their reasons range all over the lot: seat belts are troublesome to put on, they are uncomfortable, or they wrinkle your clothes. Some people even think getting hurt or killed in a car accident is a question of fate; and, therefore, seat belts don't matter.

If you're one of those people who don't use belts for one reason or another, please think carefully about your motivations. Are your objections to seat belts based on the facts or on rationalizations?

Here are a few of the common rationalizations. Many people say they are afraid of being trapped in a car by a seat belt. In fact, in the vast majority of cases, seat belts protect passengers from severe injuries, allowing them to escape more quickly. Another popular rationalization: you'll be saved by being thrown clear of the car. Here again, accident data have proved that to be untrue—you are almost always safer inside the car.

Some people use seat belts for highway driving, but rationalize it's not worth the trouble to buckle up for short trips. The numbers tell a different story: 80% of all automobile accidents causing serious injury or death involve cars traveling under 40 miles per hour. And three quarters of all collisions happen less than 25 miles from the driver's home.

When you're the driver, you have the psychological authority to convince all of the passengers that they should wear seat belts. It has been shown that in a car, the driver is considered to be an authority figure. A simple reminder from you may help save someone's life.

Another common myth: holding a small child in your arms will provide the child with sufficient protection during a crash. The safety experts disagree. They point out that even during a 30 mph collision, a 10-pound child can exert a 300-pound force against the parent's grip. So please make sure Child Restraint Systems are used for children who aren't old enough to use regular seat belts.

If you're an employer, encourage your employees to wear seat belts. At GM, we've made it a matter of policy that everyone riding in company-owned vehicles is expected to wear lap and shoulder belts.

We heartily support the program initiated by the National Highway Traffic Safety Administration to encourage the use of seat belts. So please fasten your own belt, and urge your family and friends to follow your example. Even the best driver in the world can't predict what another driver will do.

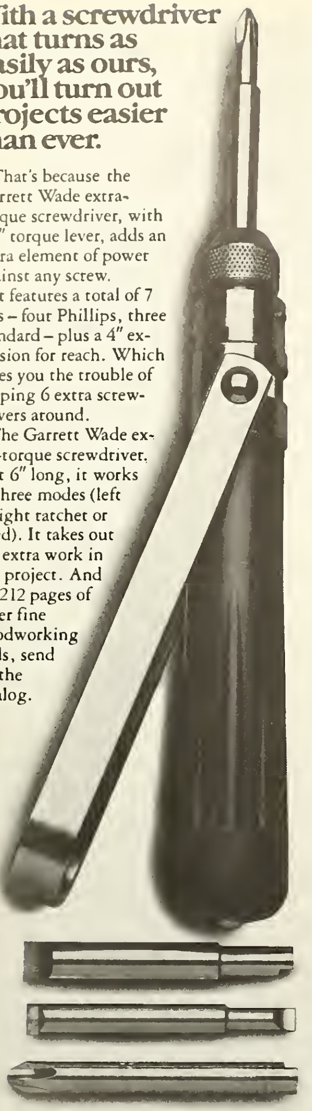
This advertisement is part of our continuing effort to give customers useful information about their cars and trucks and the company that builds them.

GM
MARK OF EXCELLENCE

General Motors

Chevrolet • Pontiac
Oldsmobile • Buick
Cadillac • GMC Truck

With a screwdriver that turns as easily as ours, you'll turn out projects easier than ever.



That's because the Garrett Wade extra-torque screwdriver, with a 3" torque lever, adds an extra element of power against any screw.

It features a total of 7 bits – four Phillips, three standard – plus a 4" extension for reach. Which saves you the trouble of keeping 6 extra screwdrivers around.

The Garrett Wade extra-torque screwdriver. Just 6" long, it works in three modes (left or right ratchet or fixed). It takes out the extra work in any project. And for 212 pages of other fine woodworking tools, send for the catalog.

Offer expires Sept. 30, 1982

Garrett Wade Co.,
Dept.74
161 Ave. of the Americas
N. Y., N. Y. 10013

☐ Send me ____ extra-torque screwdriver(s) @ $26.95 p.p d. each plus a free 16 page introductory catalog.
☐ Send your complete 212 page catalog of woodworking tools, machinery & accessories. Enclosed is $3.
☐ Check or money order ☐ Visa/MasterCard/American Express.
____ Amount enclosed. (Add sales tax for NY State residents)
Card No. ____ Expires ____
NAME ____
ADDRESS ____
CITY ____
STATE ____ ZIP ____

for all my descriptions, but I began by reading several popular renditions. All versions written for nonscientists speak of fused males as the curious tale of *the* anglerfish—just as we so often hear about *the* monkey swinging through trees, or *the* worm burrowing through soil. But if nature teaches any lesson, it loudly proclaims the theme of diversity. There ain't no such abstraction as *the* clam, *the* fly, or *the* anglerfish. Ceratioid anglerfishes come in nearly 100 species, and each has its own peculiarity. Fused males have not evolved in all species. In some, males attach temporarily, presumably at times of spawning, but never fuse. In others, some males fuse and others become sexually mature while retaining their bodily independence. In still others, fusion is obligatory. In one species of obligate fusers, no sexually mature female has ever been found without an attached male—and the stimulus provided by male hormones may be a prerequisite for maturation.

These obligate fusers have become the paradigm for popular descriptions of *the* anglerfish, but they do not represent the majority of ceratioid species. I grouse because these meaningless abstractions convey one of the most seriously false impressions about nature that we can form. They greatly exaggerate nature's discontinuities by focusing on extreme forms as false paradigms for an entire group, and rarely mentioning the structurally intermediate species that often live happily and abundantly. If all fishes either had totally independent or completely fused males, then how could we even imagine an evolutionary transition to the peculiar sexual system of *the* anglerfish? But the abundance of structurally intermediate stages—temporary attachment or fusion of some males only—conveys an evolutionary message. These modern structural intermediates are not, of course, actual ancestors of fully fused species, but they do sketch an evolutionary pathway—just as Darwin studied the simple eyes of worms and scallops to learn how a structure so complex and apparently perfect as the vertebrate eye might evolve through a chain of intermediate forms. In any case, bursting diversity is nature's watchword; it should never be submerged by careless abstraction.)

Ceratioid males embark upon their peculiar course early in life. As larvae, they feed normally and live independently. After a period of rapid change, or metamorphosis, males in species destined for fusion do not develop their alimentary canals any further, and never feed again. Their ordinary teeth disappear, and they retain and exaggerate only a few fused teeth at the tips of their mouth—useless in feeding, but well adapted for piercing and holding tight to a female. They become sleek and more streamlined, with a pointed head, compressed body, and strong, propulsive tail fin—in short, a sort of sexual torpedo.

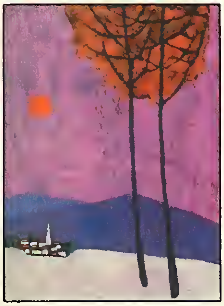
But how do they find females, those tiny dots of connubial matter in the midst of an endless ocean? Most species must use olfactory cues (odor), a system often exquisitely developed in fishes, as in homing salmon that smell out their natal stream. These ceratioid males develop gigantic nostrils after metamorphosis; relative to body size, some ceratioids have larger nasal organs than any other vertebrate. Another family of ceratioids fails to develop large nostrils, but these males have enormously enlarged eyes, and they must search for the ghostly light of fishing females (each species has a different pattern of illumination, and males probably recognize their proper females). The system is not entirely fail-safe, as ichthyologist Ted Pietsch recently found the male of one species attached to the female of a different species—a fatal mistake in evolutionary terms (although the two fish had not fused and might later have separated had not zealous science found and preserved them *in flagrante delicto*).

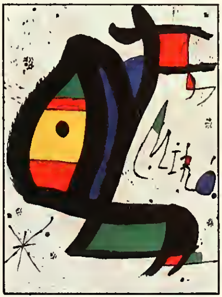
As I sit here wiggling my toes and flexing my fingers in glorious independence (and with a full one-inch advantage over my wife), I am tempted (but must resist) to apply the standards of my own cherished independence and to pity the poor fused male. It may not be much of a life in our terms, but it keeps several species of anglerfishes going in a strange and difficult environment. And who can judge anyway? In some ultimate Freudian sense, what male could resist the fantasy of life as a penis with a heart, deeply and permanently embedded within a caring and providing female? These anglerfishes represent, in any case, only the extreme expression of nature's more common pattern—smaller males pursuing an evolutionary role as sources of sperm. Do they not, therefore, teach us a generality by their very exaggeration of it? We human males are the oddballs.

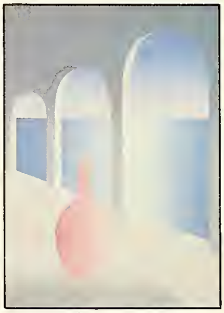
I therefore take my leave of fused anglerfishes with a certain sense of awe. Have they not discovered and irrevocably established for themselves what, according to Shakespeare, "every wise man's son doth know"—"journeys end in lovers meeting."

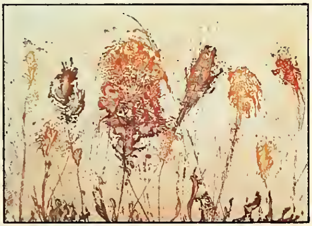
Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

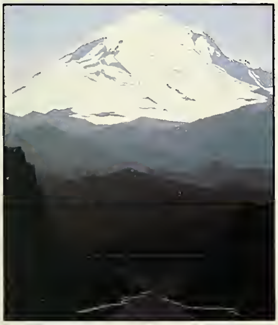
What your home could have in common with the Met, the Tate, and the Louvre.

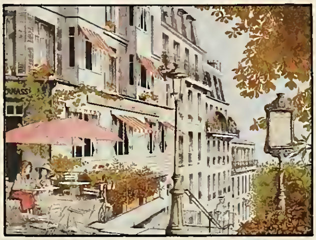

David Shapiro's *Landscape with Village*, original serigraph. Signed limited edition of 125.


Joan Miro's *Miro – Obra Grafica Exhibition 1978*, original lithograph. Signed limited edition of 99.


Peregrine King's *Pink Vase II*, original serigraph. Signed limited edition of 175.


Georges Vial's *Fireworks*, original etching. Signed limited edition of 99.


Jerome Schurr's *Mt. Rainier*, original serigraph. Signed limited edition of 290.


Denis Paul Noyer's *La Terrase*, original lithograph. Signed limited edition of 300.

In your own home, you can exhibit original work by artists who are represented in the world's great museums and galleries.

Artists like Calder. Chagall. Dali. Miró. Picasso. Vasarely.

At the Original Print Collectors Group, we offer moderately priced limited edition prints by these and other well-known artists.

Our offerings include signed original etchings, engravings, lithographs, woodcuts, and silkscreen prints.

Each print we offer is signed and numbered by the artist. Custom-framed. Accompanied by a certificate of authenticity and a full money-back guarantee.

And each print has been chosen not only for its beauty but for its investment value.

(Works by the artists we offer tend to appreciate, sometimes as much as 30% in a single-year. Perhaps that's why *The Wall Street Journal*, *Business Week*, *Money*, AP, *Barron's* and UPI have quoted us as an authority on investing in art.)

For more information, send in the coupon. There's no obligation.

You'll find out about the special pleasure of owning original art, instead of just visiting it.

Visit our new gallery located at 215 Lexington Avenue,
Mon–Fri, 9–5 PM. Telephone: 212-685-9400 Ext: 35

Original print collectors group, Ltd.
215 LEXINGTON AVE., DEPT. NH-42,
NEW YORK 10016

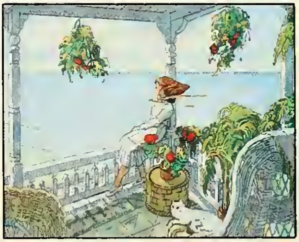
PLEASE SEND ME YOUR FREE COLOR CATALOGUE WITHOUT OBLIGATION.

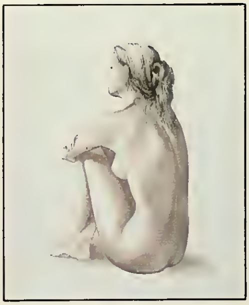
NAME ______________________
PLEASE PRINT

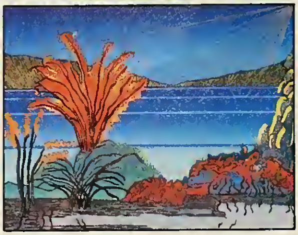
ADDRESS ______________________

CITY ______________________

STATE __________ ZIP __________


Suzanne Lemieux's *Summer Reverie*, original hand-colored etching. Signed limited edition of 195.


Virginie Manzano's *Delphine*, original lithograph. Signed limited edition of 350.


Jarle Rosseland's *A Clear Day*, original woodcut. Signed limited edition of 225.

© 1982 OPCG, LTD

Winners of the 1982 Natural History Photographic Competition

Each year, as our Photographic Competition rolls around, the winners must be separated from the also-rans—and the task never gets any easier. Thousands of entries pour in from both professional and amateur photographers, practicing scientists and just plain folks. In 1982, each contestant was allowed to submit up to five entries, in any combination of five broad categories: Animals (including birds and bugs); Plants and Their Environment; The Human Family; A Sequence in Nature (up to five photographs); and Humor in Nature. The art staff of *Natural History* screened all the entries and submitted about four hundred finalists to our panel of three judges: John Durniak, Ann Guilfoyle, and Ernest Scarfone. Durniak, at present the picture editor of *The New York Times*, has been associated in the past with *Life* magazine, United Press, *Popular Photography*, *Time*, and *Look*. Guilfoyle, previously the photo editor for *Audubon* magazine, is now a "roving picture editor and book packager." Her most recent project has been editing *Wildlife Photography: The Art and Technique of Ten Masters*, by Susan Rayfield; she also edits the *Guilfoyle Report*, a quarterly newsletter for photographers. Scarfone, vice president for graphics and production of ABC Leisure Magazines and associate publisher of *Modern Photography*, is also president of Art Directors Publications.

By repeatedly viewing the slides and prints, the judges were able to narrow their selection to a manageable number of favorites. As the First Prize winners for the five categories began to emerge, the merits of the top contenders were examined and debated. Agreeing quickly on which photograph should receive the Grand Prize, the judges soon resolved their differences and concluded their official duties by bestowing ten Honorable Mentions. In reviewing their work, they remarked that a number of the selections were rather monochromatic—perhaps this was only fitting, for no black-and-white entry received a prize this year.

In a departure from previous contests, the cover photograph featured on this issue of *Natural History* was separately chosen by the magazine's designer and editor. Strong design, wide appeal, vertical format, and space for the magazine's logo were among the points considered for this special Cover Photograph Award. This year, at any rate, seasonal appropriateness was not a factor. Of course, the winter scene may not seem at all inappropriate to those of our readers who inhabit the Southern Hemisphere.

We extend our thanks to all the participants in the competition. For those who didn't "place," remember, there is always next year. The deadline and rules for the 1983 contest will be published in a future issue of *Natural History*.

Vittorio Maestro

GRAND PRIZE

RAYMOND J. PUPEDIS

The narrow-winged damselfly that unwittingly became the star of our photographic competition was raised in an aquarium, along with other laboratory specimens. One day, Raymond J. Pupedis walked into the lab and found the insect flying around—the inevitable metamorphosis had taken place. He managed to get just a few pictures, using a flash, before the damselfly escaped out an open window. Pupedis, a graduate student in systematic and evolutionary biology at the University of Connecticut, is currently writing his dissertation on New England insects of the family Sisyridae.

FIRST PRIZE
The Human Family

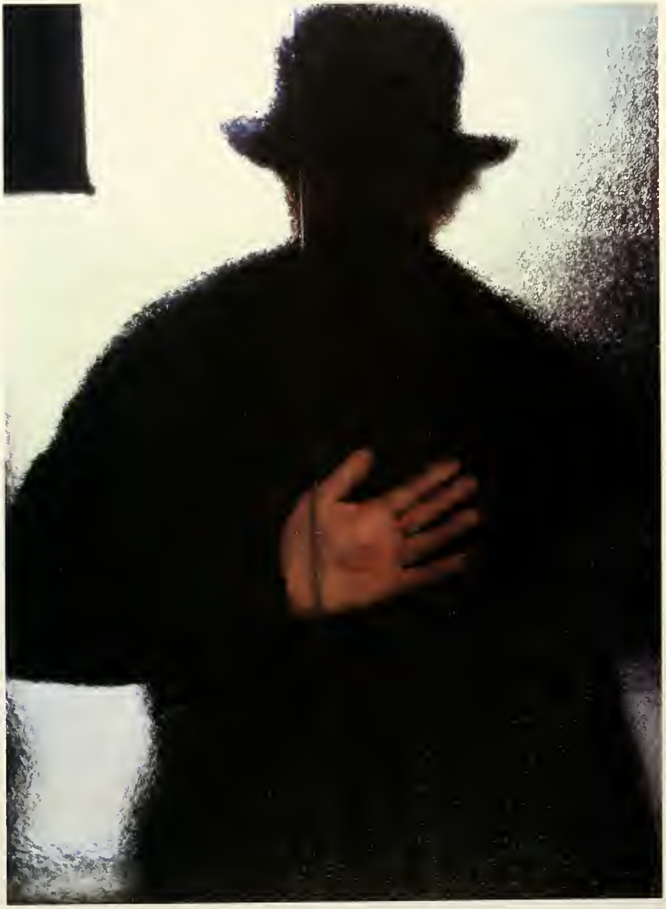
Ross Hudson

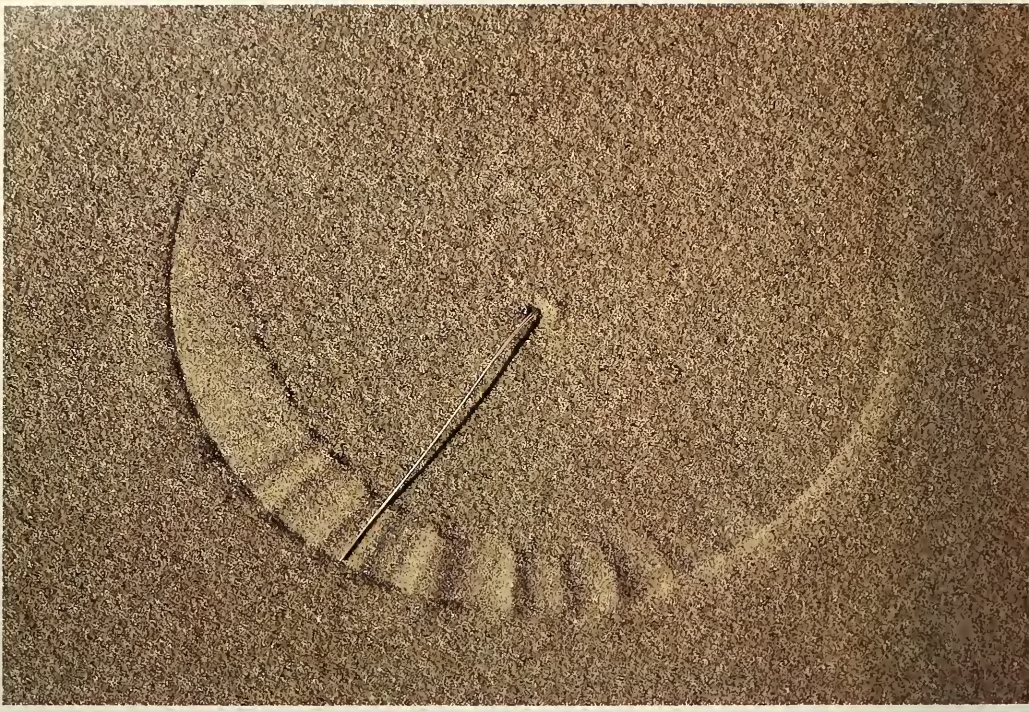
While on a train in central Pennsylvania, Ross Hudson took a series of photographs of a nuclear plant. With the idea of conveying the effect such a remote installation might have on the city environment, he rewound the film and made second exposures in New York City, where he lives. Hudson is a free-lance advertising art director.

HONORABLE MENTION
The Human Family

ALBERT GUNNELL

The hand and hat belong to an old woman, waiting at a glass-enclosed bus stop in Nice, France. Albert Gunnell, a post office employee who lives in Jersey City, New Jersey, took the picture while on a summer vacation.





FIRST PRIZE
Plants and Their Environment

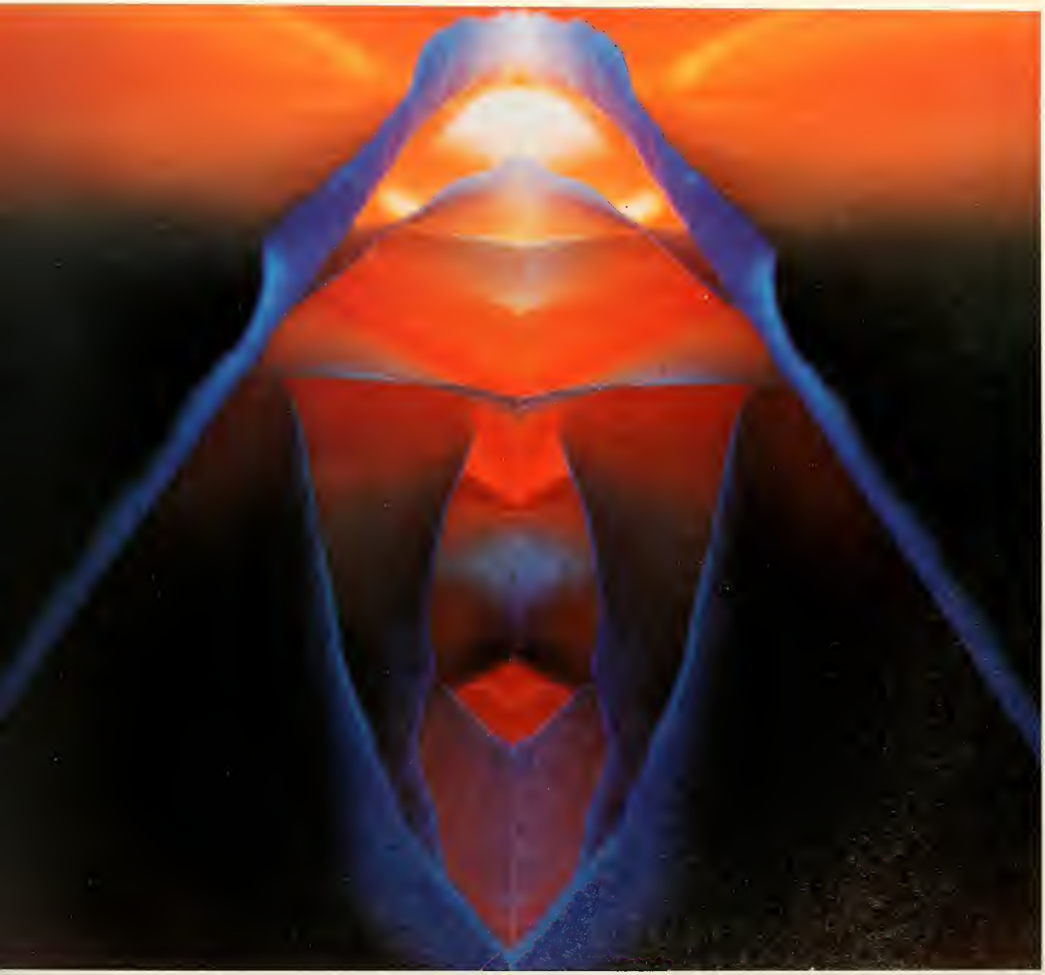
BARRY SNYDER

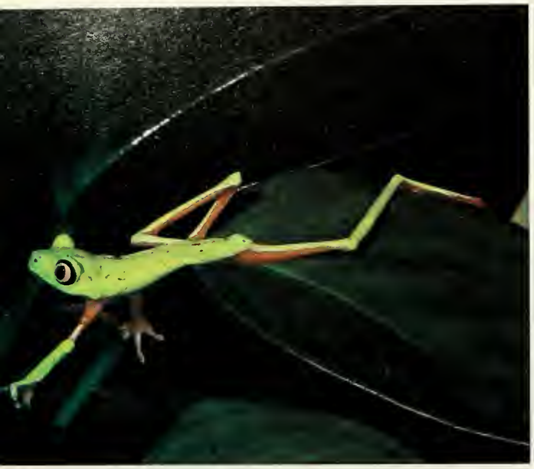
While on a beach in northern Cape Cod, Barry Snyder became intrigued by the patterns in the sand made by the wind-blown grass. This one attracted him because of its simplicity, the grace of the arc, and the sense of near completion. Snyder lives in Burlington, Vermont, and is a ferryboat captain on Lake Champlain, plying between Charlotte, Vermont, and Essex, New York.

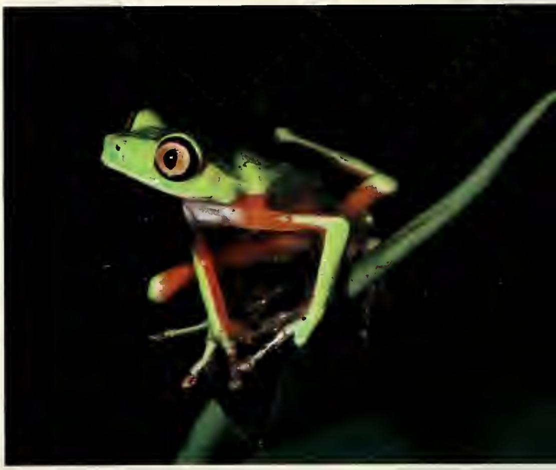
FIRST PRIZE
Humor in Nature

Kathleen D. Karp

This creation is actually a detail of a rose and its reversed image photographed side by side to form a symmetrical pattern. Kathleen D. Karp is aware that some people see a human face in the pattern, but the specific image she focused on was the triangle. Karp, a professional photographer in New York City, says that her experimentation with this type of work became, for her, something of a spiritual experience.





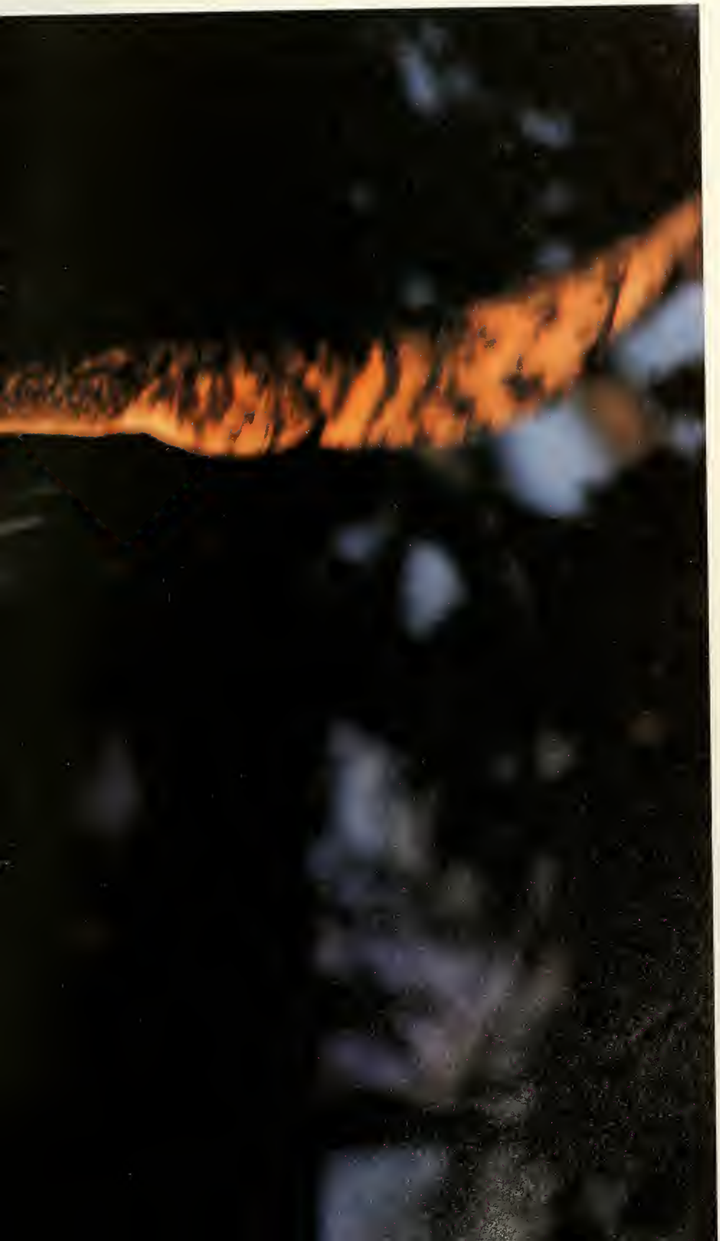


FIRST PRIZE

A Sequence in Nature

MARK W. SKINNER

A graduate student in the Department of Organismic and Evolutionary Biology at Harvard University, Mark W. Skinner takes pictures of plants and animals to illustrate lectures and to document his scientific work. In the summer of 1981 he received funding to study bird behavior in the Monteverde Cloud Forest Reserve in Costa Rica. While there, he encountered this tree frog (*Phylomedusa lemur*) and shot a series of pictures as it moved over a log covered with mosses and vines.



FIRST PRIZE
Animals

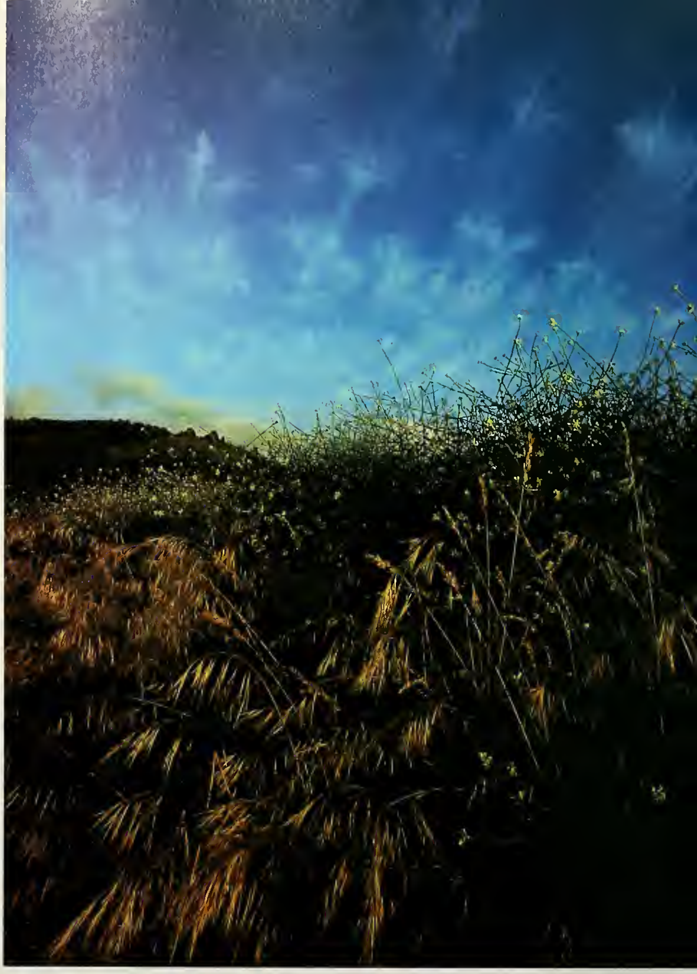
W. Samuel Tripp

W. Samuel Tripp is a dentist who lives on a farm near Medicine Hat, Alberta, Canada. Horned owls habitually nest in his wood lot; Tripp obtained this photograph by prefocusing his camera and having his son rap the tree to force the subject into range.

HONORABLE MENTION
Plants and Their Environment

Sanford Edelstein

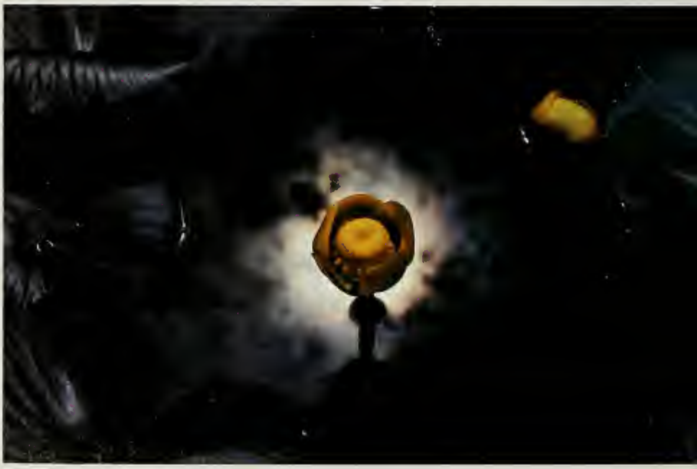
Sanford Edelstein, a resident of Salinas, California, has "the advantage of being able to head down the coast any time the weather looks interesting—which isn't that often, due to the late afternoon fog." He took this photograph about two miles north of Point Lobos. Edelstein is studying drafting technology at Hartnell College.



HONORABLE MENTION
Plants and Their Environment

Mark B. Moore

While hiking in Washington's Olympic National Park, Mark B. Moore took this photograph of a water lily at Elk Lake. The midday sun's reflection in the water, directly behind the blossom, provided an unusual lighting effect, which was enhanced by the use of a polarizing filter. Moore, a meteorologist whose concern is forecasting avalanches, lives in Bothell, Washington.



HONORABLE MENTION
Plants and Their Environment

Craig Corbett

There are many summer lightning storms on Captiva Island, Florida, which is near Fort Myers. One July night, before the rain hit, Craig Corbett placed his camera on a tripod and set it for a ten-minute exposure—just long enough to go in and enjoy a cool beer. A civil trial lawyer, Corbett lives in Orlando, Florida.

HONORABLE MENTION
Animals

Lowell D. Franga

To get this striking image, Lowell D. Franga made a double exposure, photographing a mountain lion in Wyoming with a 1,000-mm telephoto lens and the moon with a 500-mm telephoto lens. Franga, a personnel manager, lives at present in Dudeldorf, West Germany.

HONORABLE MENTION
The Human Family

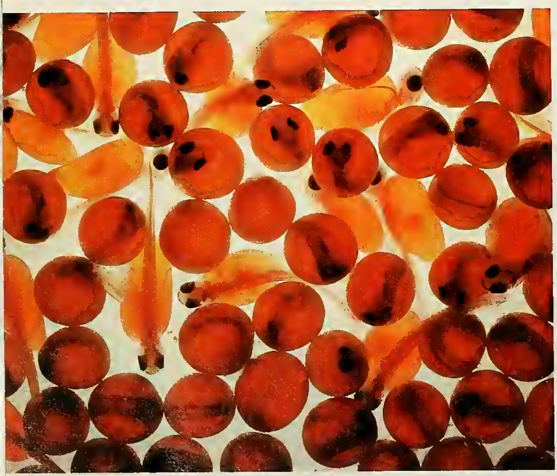
Rodney Brown

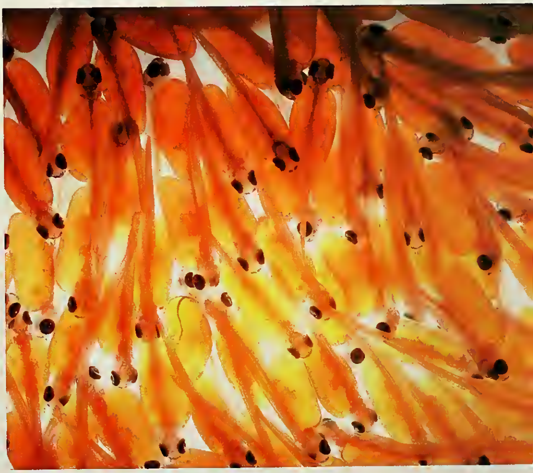
Rodney Brown, a printer who lives in Spartanburg, South Carolina, got up early one fall morning, intending to photograph the sunrise at Camp Croft State Park. Arriving late, he found that in any case the sun would have been obscured by fog, but he did get this picture of a local fisherman out after bass.

HONORABLE MENTION
A Sequence in Nature

Terry Domico

A free-lance photographer and picture editor with Earth Images Agency, Terry Domico recorded stages of salmon development for a forthcoming book about the commercial fisheries of the Pacific coast. The first three photographs were made in his studio; the last, of salmon parr, was taken at the Washington State salmon hatcheries. Domico lives on Bainbridge Island, Washington.

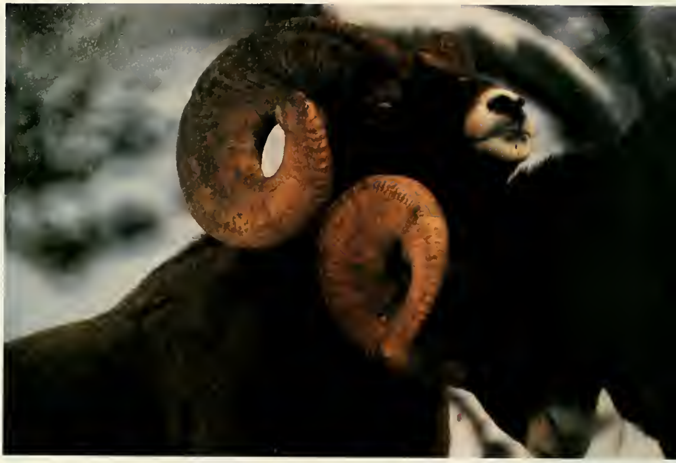




HONORABLE MENTION
Animals

Willard L. Colburn

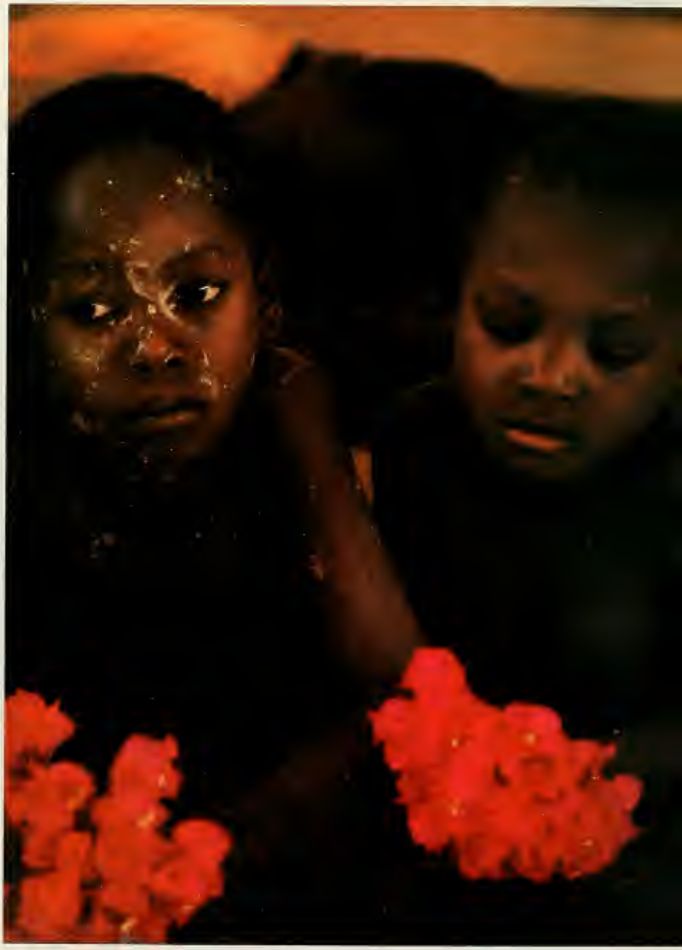
The two bighorn sheep had just butted their heads when Willard L. Colburn took this picture at Yellowstone National Park (Montana) in November of 1978. A house painting contractor in Eugene, Oregon, Colburn returned to Yellowstone for more pictures this past year. Sadly, he reports that this time he saw sheep walking in circles and falling off bluffs, victims of the current epidemic of pinkeye.

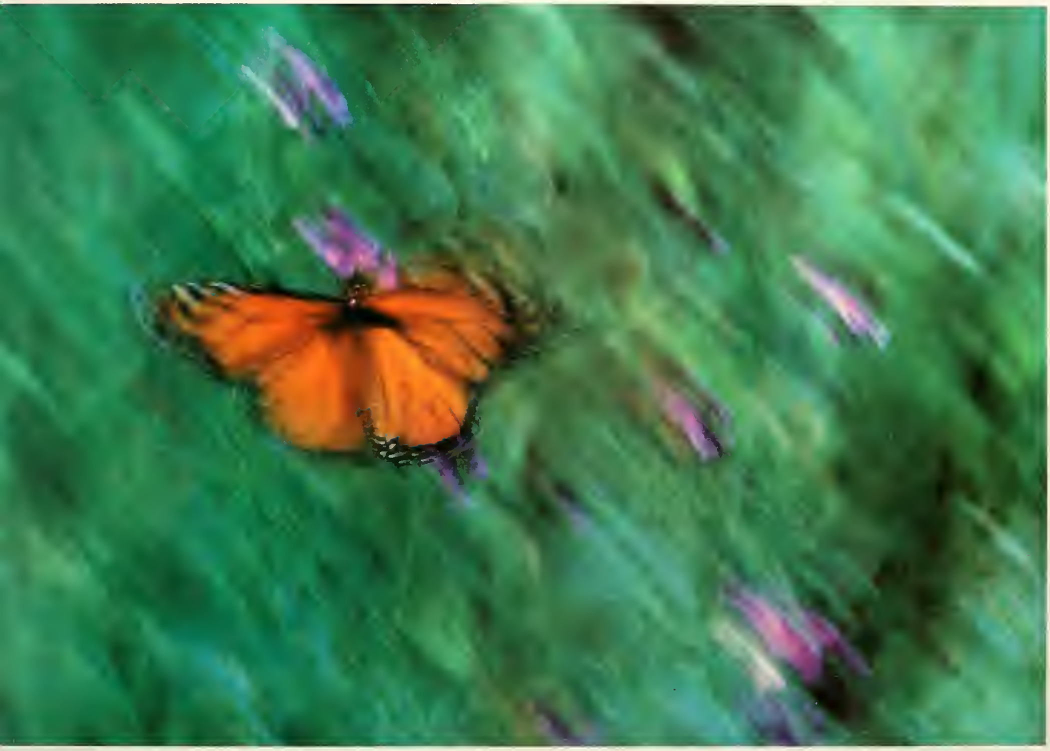


HONORABLE MENTION
The Human Family

Niko Anastasakos

For his summer vacation in 1978, Niko Anastasakos went to West Africa on an arts and crafts tour, in which participants had the opportunity to work with native craftsmen. While in Ghana, he met and photographed these children, who had come into their schoolhouse after playing in mud. Anastasakos is a biochemist and lives in Brooklyn, New York.





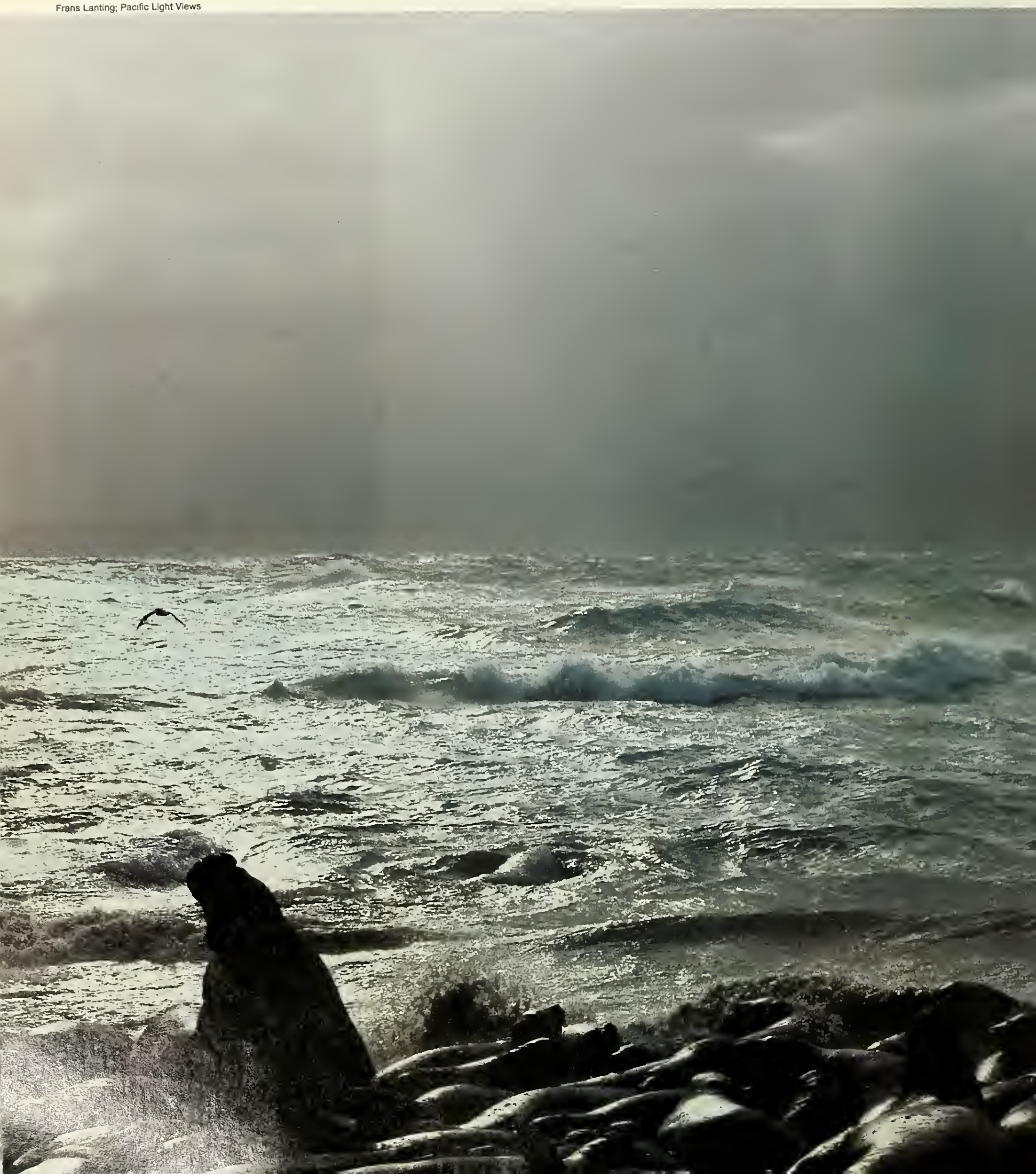
HONORABLE MENTION
Animals

MARK WILSON

While trying to photograph a monarch butterfly in a hayfield dotted with alfalfa blossoms, Mark Wilson found that his slow film was no match for the high wind. Turning the situation to his own advantage, he experimented with a slow shutter speed, capturing a puff of wind and color at the same time. Wilson, who lives in Tewksbury, Massachusetts, and does some photography and writing for a local newspaper, received his B.S. in biology this spring from the University of Lowell.

Two bulls stand guard over their harems as a January storm lashes the elephant seal rookery on Año Nuevo Island off the coast of California. This is the height of the breeding season, which concludes in mid-March.

Frans Lanting; Pacific Light Views



Born Again Seal

With the help of two governments, the gargantuan elephant seal is reconquering the California coast

by Gerald F. Carroll

Prior to the coming of Europeans to the west coast of North America, marine mammals abounded along the shores. Sea otters, seals, and sea lions, in particular, teemed in the coastal environment, inhabiting offshore islands and hard-to-reach places along the shoreline. Some animals would fall prey to the local Indians or to a marauding grizzly bear, but for the most part, they were safe from terrestrial predation. Whatever fluctuations occurred in their numbers were due to natural forces.

This situation changed drastically in the nineteenth century when whalers from New England arrived and found marine mammals to be an easily exploitable resource. Few other animals have been hunted so relentlessly and brought so near to the edge of extinction. One species after another was decimated until it was no longer profitable to hunt the few animals that were left. The northern elephant seal was among those species that came close to disappearing forever. Originally, large populations of elephant seals ranged from Cape San Lázaro, Baja California, north to Point Reyes, above San Francisco. Unlike the fur seal, elephant seal pelts had no commercial value, but the animals were hunted for their oil, which was considered superior to whale oil for lubricating purposes. An adult male elephant seal, when rendered, could yield more than 200 gallons of oil. Hundreds of thousands of elephant seals were slaughtered, and their numbers were so quickly reduced that by the 1860s there were too few left to pursue. Only a remnant population, perhaps 100 animals, survived on and around Guadalupe Island off the coast of Baja California.

When hunting ceased, the number of elephant seals began to increase. In 1922, fearing the seals might attract commercial attention again, the Mexican government banned all hunting of these animals. By the 1930s they had expanded their range and were appearing in United States waters, where they were also given protection. Eventually, the animals reappeared at Año Nuevo Island, an ancestral breeding ground off the central California coast. In 1957, the state of California set aside the island and about 1,000 acres of

Locked in battle over control of a choice parcel of the breeding beach, two bulls roil the waters offshore. Such fights are often gory, but serious injuries are rare.

R. Gildart; Tom Stack and Associates

A dominant bull, having established his breeding territory, roars a warning at an intruding male.

Frans Lanting; Pacific Light Views

the adjacent shoreline promontory as a reserve for the seals. The first pups were born at the reserve in the winter of 1960–61—an event that marked the elephant seal's reconquest of an important part of its former range. Elephant seals are now so numerous at the reserve that they also use the mainland beaches as breeding grounds.

Año Nuevo State Reserve lies along the coast highway, about sixty miles south of San Francisco. Windswept dunes cover the area near the tip of the promontory; high cliffs rise from narrow sand beaches on the southern end of the mainland portion of the reserve. A few hundred yards offshore lies eight-acre Año Nuevo Island. Due to the strong tidal currents that surge between the island and the mainland, access is dangerous and visitors must obtain authorization. An old farmhouse, where the former owners of the property once lived, is now headquarters for the state personnel assigned there.

The reserve is a haven for four species of pinnipeds, a suborder that includes seals, sea lions, and walruses. California sea lions and harbor seals lounge on large rocks, just offshore. (The California sea lion is familiar to all zoo and circus goers; it is the most easily trained of all the seals.) The Steller sea lion shares the reserve and the island is its primary rookery along the California coast. By far the most popular inhabitant with visitors to the reserve is the northern elephant seal, which, by breeding on the mainland beaches as well as on the island, is the most visible.

There are two closely related species of elephant seals in existence. The southern elephant seal inhabits the Southern Hemisphere; it is found in the subantarctic and its range is circumpolar. Its largest rookeries are on South Georgia Island in the South Atlantic, the Kerguélen Islands in the Indian Ocean, and Macquarie Island in the South Pacific. It is also abundant in and around the Falkland Islands. This seal was subjected to heavy hunting pressure until the British government regulated the harvest in the Falkland Islands; hunting continued until 1965, when it was finally halted. The northern elephant seal is found only along the west coast of North America. It has made a remarkable recovery from near extinction: with a population now estimated at 70,000 animals, this seal has almost recovered its original range.

The elephant seal is by far the largest of the pinnipeds. An adult male may reach a length of twenty feet and weigh 8,000 pounds. By comparison, a bull Pacific walrus can attain a length of fourteen feet

A newly weaned pup has to fend for itself, as its mother will have nothing further to do with it. Known as weaners, such pups join together in pods along the shoreline, living off their fat reserves. They head out to sea in May.

Frank S. Balthis

and, when carrying maximum blubber, weigh 3,700 pounds. The male elephant seal is considerably larger than the female, whose maximum weight is about 2,000 pounds, or one-fourth that of the male. Their name is derived not from the animals' huge size, however, but rather from the prominent, pendulous proboscis that adorns the adult males. During the breeding season, when the males are competing among themselves for breeding dominance on the beaches, the proboscis becomes engorged with blood, making it even more prominent. When a bull signals a challenge or threat to another, he rears up, bending his head, neck, and shoulders back, and snorts down through his nose. This produces a booming, bellowing sound that can carry for about a quarter of a mile.

The breeding season for elephant seals at Año Nuevo begins in early December, when the adult males arrive at the rookery, and continues through to mid-March. Only the largest, most dominant males, known as beachmasters or alpha males, will be successful in the competition for females. The elephant seal is not as strictly territorial as some other pinnipeds; instead, a social hierarchy is established. The most dominant males claim the right to control the area of beach occupied by the most females. Studies have shown that 85 percent of the females will be inseminated by a mere 4 percent of the males.

A few weeks after the males come ashore, the females arrive and join them on the beaches; they have no interest in the males at this time and generally lie about the beach ignoring them. In about a week the females give birth to single, black, woolly pups. About 1,400 pups were born at Año Nuevo during the 1981–82 season. The pups weigh between 45 and 100 pounds at birth, and feeding on their mother's milk, which is about 55 percent butterfat, they gain pounds rapidly. In eleven days their weight will have doubled, and by the end of the month it will have quadrupled—a gain of about ten pounds a day.

After about a month the pups are weaned and are referred to as weaners. They join in groups, or pods, along the shoreline and in tidepools, and molt their woolly coats, which are replaced by sleek, gray hides similar to that of the adults. Because the mothers are becoming receptive to the males, they will have nothing more to do with their offspring, which must now fend for themselves.

The beachmasters mate with as many females as possible. The younger males, those less than twelve years old, are generally not successful at establishing a territory on the beach. They loiter around the perimeter of the breeding area or farther inland. These young bulls occasionally attempt to invade the territories of the dominant males and mate with the females. At the first sign of such an encroachment, a beachmaster will charge toward the intruder, bellowing a warning. A rapidly charging, enraged bull elephant seal is a hazard to all around him. Helpless pups in the path of a bull are often crushed to death. Pups suffer an overall mortality rate of about 17 percent, and many of these are killed by charging bulls that are oblivious to their presence.

The threatening display of the territorial bull is usually enough to discourage interlopers, but some choose to hold their ground and meet the charge. In such a situation, the two males confront one an-

A breeding bull will not leave his territory to feed until the mating season is over. This requires a great amount of stamina, and the bulls seem exhausted by March.

Frank S. Balthis

other, then rise up and smash the bulk of their necks and shoulders into each other. At the same time, they attempt to slash each other with their canine teeth. The contest is heated, but serious injury is rare. The battle continues until one gives way and retreats, usually the younger challenger. A defending male is seldom driven off his territory; if he were that weak, he probably could not have established a territory in the first place. The fight is impressive and often gory, but most damage is restricted to the heavily fatted neck and shoulder area. Occasionally, a male is seen with an injury around the eye socket or to the vulnerable proboscis, presumably received in one of these battles.

The gestation period for elephant seals is nine months, but their breeding strategy requires that they give birth eleven months after mating—to keep in step with their yearly cycle. To meet these requirements, a reproductive adaptation known as delayed implantation is utilized. The fertilized ovum is held in a sort of limbo for two months before being implanted in the uterus to begin its development. Not a great deal is known about the mechanism of this adaptation, but it is shared by a number of animals, such as martens, weasels, mice, and some marine mammals.

Mating is usually completed by March, and the adults then go into the sea to feed. The males have been on the beach continuously since coming ashore in early December and so have fasted for three months. Defending their territory and mating demand a heavy expenditure of energy from the bulls, but they will not leave their territories to feed until mating is done. The stamina required of the males in order to be successful at breeding may be a partial explanation for the huge size they attain.

When the adults depart, the young of the year are left behind on the beaches. Elephant seals are not the most attentive parents: the males are only involved with the actual mating; the mothers give birth and nurse, then abandon their young after they are weaned. This may contribute to the pups' high mortality rate relative to other pinnipeds. With the departure of the adults, immature elephant seals—those perhaps less than seven years old and not yet ready to join the breeding population—come onto the beaches and join the weaners. By late May, these animals have left the island, to be replaced by a wave of young and subadult males that come ashore to undergo a molt during the summer. When these seals leave, in late summer, they are replaced by another influx

Nursed on its mother's rich milk, a recently born elephant seal pup will gain the nourishment that will enable it to quadruple its weight in a month. The pups weigh an average of sixty-five pounds at birth and gain up to ten pounds a day until they are weaned.

Frank S. Balthis

of immature animals. Many species of seals have a strong attraction for the site on which they were born; they may never come ashore anywhere else during their lifetime. Elephant seals seem to have regulated their biological clocks so that each age group of animals may use the home territory for their special needs at a different time and so not interfere with each other—nature's version of time sharing.

No one is sure just where the elephant seals go when they leave the rookery; apparently they spend their time in the open sea, not in groups, but singly. Young of a particular year that have been banded at the rookeries off the coast of Baja California have appeared along the central California coast within a few months. Feeding and survival are now their only concerns until the next breeding season. The northern elephant seal is known to feed on fish and squid, supplemented by an occasional shark, skate, or ratfish.

Under the protection of the Mexican and United States governments, the northern elephant seal has made a remarkable recovery from the mere handful that survived at Guadalupe Island, but potential problems remain. The drastic reduction of a species to a remnant population, especially a species where so many of the offspring are sired by the same father, imposes a genetic sameness on those offspring. Biologists refer to this as a "genetic bottleneck" and conclude that some degree of variability has been lost by the species. It is genetic variability that contributes to hardiness—the ability to withstand stress and changing environmental conditions. What affects one elephant seal is now much more likely to affect them all, due to this genetic homogeneity.

Recent on-again, off-again proposals to open the area just offshore to exploration and possible drilling for oil have caused concern to those who want to see these animals continue to flourish. A lease proposal by the Department of the Interior would open five basins along the California coastline to exploration, one of which is the Santa Cruz basin. The Año Nuevo reserve lies within this basin. No one knows what the effect of an oil spill, washing up on the beaches of the rookery, would be—to either the elephant seals or their food sources in and around the reserve. Nor can anyone predict the impact on the seals' highly tuned and regulated breeding cycle of all the traffic and exploratory activity. These and other questions deserve more study before the proposals are developed further. These magnificent animals were driven from this rookery once before; with luck and effort, it will not happen again. ☐

A bull rests in a pond behind the beach. Bulls that are unable to establish a breeding territory usually loiter at the edges of the rookery.

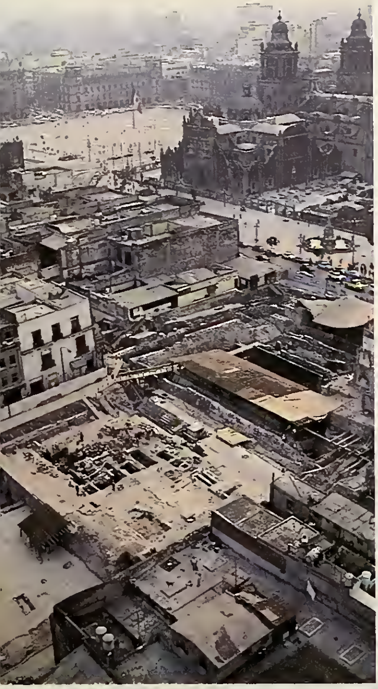
Frank S. Balthis

Revelation of the Great Temple

by H. B. Nicholson

Archeologists have uncovered the ritual heart of the Aztec empire, concealed since the Spanish conquest

David Hiser; reproduced with permission of the Mexican National Institute of Anthropology and History



Above: The location of the Great Temple, near the Cathedral of Mexico (upper right), was confirmed early this century. Systematic excavation of the site (shown here in progress in 1979) was organized four years ago, following the accidental discovery of a spectacular stone monument that was part of the temple. Facing page: Among the most revealing discoveries during the current excavation have been offertory caches that the Aztecs deposited when they built and renovated the Great Temple. Many of the objects in these caches, such as this "Mezcala" stone mask, were stylistically non-Aztec and evidently came from distant provinces of the empire.

"The second year after the foundation of Mexico [in 1325] the Mexicans began to lay the foundations for the large and important temple of Huitzilopochtli, which constantly increased in size, for each of the lords who successively ruled in Mexico enlarged it as much again as it had been constructed by the first inhabitants—and thus the Spaniards found it very high, very strong, and very much to look at." So one of the earliest and most authentic histories of pre-Hispanic Mexico describes the original erection and constant renovation of the Great Temple, the single most important ceremonial structure in the empire of the Mexica, commonly known as the Aztecs. It stood in Mexico-Tenochtitlan, the Aztec capital, over whose ruins Mexico City arose following the Spanish conquest. Only recently have archeologists uncovered the temple's remains and begun to assess their significance. The discoveries have already generated an unprecedented excitement among modern Mexicans over their ancient heritage.

At the time of the conquest, the Aztec empire consisted of a Triple Alliance between the capital and two other cities, Tetzcoco and Tlacopan. Together they dominated central Mexico and fought wars against neighboring peoples in which prisoners were taken for human sacrifice. Every important city-state within the empire had its own ceremonial center, but the most important temple complex was that of Mexico-Tenochtitlan. In 1520, the man who was to destroy the Great Temple, Hernando Cortés, described its precinct in enthusiastic terms in his second official dispatch to the emperor Charles V:

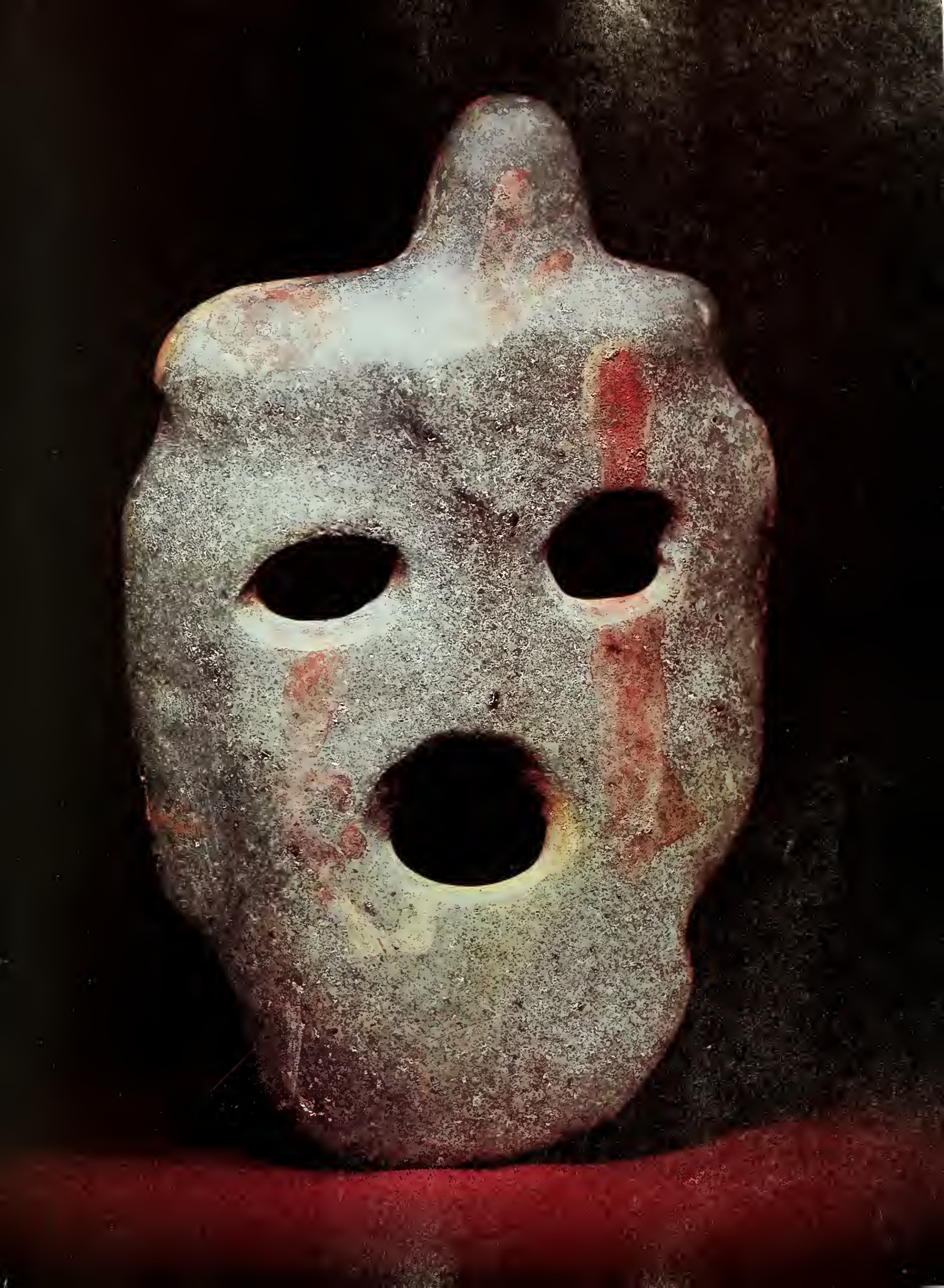
> There are, in all districts of this great city, many temples or houses for their idols.... Amongst these temples there is one [temple complex], the principal one, whose great size and magnificence no human tongue could describe, for it is so large that within the precincts, which are surrounded by a very high wall, a town of some five hundred inhabitants could easily be built. All round inside this wall there are very elegant quarters with very large rooms and corridors where their priests live. There are as many as forty towers, all of which are so high that in the case of the largest there are fifty steps leading up to the main part of it; and the most important of these towers is higher than that of the Cathedral of Seville. They are so well constructed in both their stone and woodwork that there can be none better in any place, for all the stonework inside the chapels where they keep their idols is in high relief, with figures and little houses, and the woodwork is likewise of relief and painted with monsters and other figures and designs. All these towers are burial places of chiefs, and the chapels therein are each dedicated to the idol which he venerated.... The most important of these idols and the ones in whom they have the most faith, I had taken from their places and thrown down the steps, and I had those chapels where they were cleaned, for they were full of blood of sacrifices; and I had images of Our Lady and of other saints put there, which caused Muteczuma and the other natives some sorrow... for they believed that those idols gave them all their worldly goods, and that if they were allowed to be ill treated, they would become angry and give them nothing and take the fruit from the earth leaving the people to die of hunger.

Within the precinct of this complex of temples, the most important structure—the Great Temple proper—was a high, four-tiered platform surmounted by two shrines, one dedicated to the patron deity of the Aztecs, Huitzilopochtli, and the other to Tlaloc, the ancient fertility-rain deity. Cortés estimated, in the same letter, that more than one hundred steps led to

---

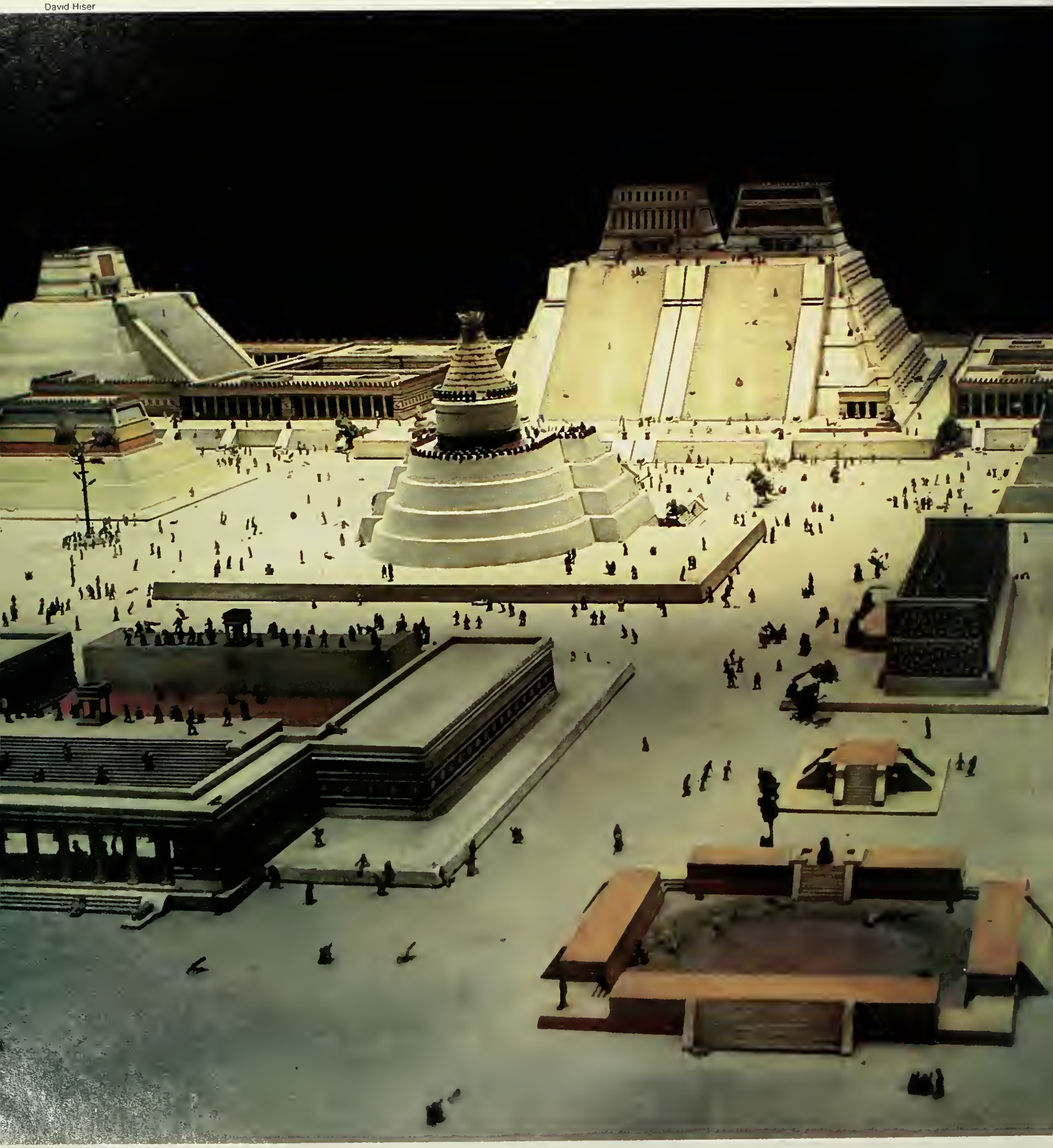
From July 27 to October 6, more than 100 artifacts found in the excavation of the Great Temple—*Templo Mayor*, in Spanish—will be shown at the American Museum of Natural History. The special exhibition, "Aztec Mexico: Discovery of the Templo Mayor," was organized by Mexico's National Institute of Anthropology and History and the Mexican Ministry of Foreign Affairs.

Fernando Robles; Mexican National Institute of Anthropology and History

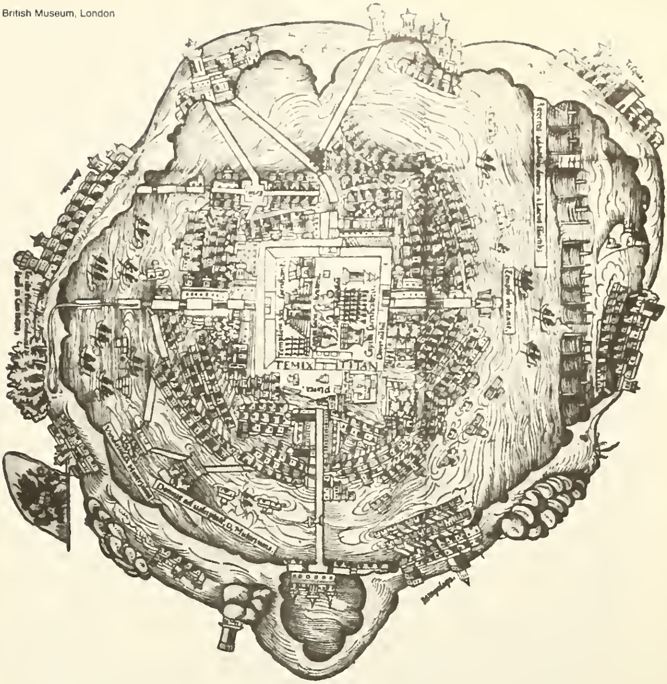


The Mexica Hall in Mexico's National Museum of Anthropology features a model of the Great Temple precinct. The Great Temple (top center) was surmounted by two shrines, the one at the right dedicated to Huitzilopochtli, the Aztec's patron deity, and the other to Tlaloc, the fertility-rain god. Designed before the current excavation, the model shows the temple about one-third too large, without some of the details that have recently been discovered.

David Hiser



This 1524 woodcut of the Aztec capital, printed in Nuremberg, Germany, was almost certainly based on a plan that the Spanish conqueror Cortés had sent to the emperor Charles V. Its schematic representation of the Great Temple precinct, in the center of the city, was the first ever published.


British Museum, London

the top of this platform, although the overall structure, including the shrines, probably fell short of the tower of the Cathedral of Seville, which at that time would have been about 200 feet high. He probably also exaggerated his feat of removing the idols, claiming he had them "thrown down the steps." Two other reliable eyewitness accounts describe how the Indians, supervised by their priests, very carefully lowered the large stone idols that stood in the two sanctuaries on the summit of the Great Temple. There are differing versions concerning the fate of these supremely sacred images, but they seem to have been successfully hidden—and attempts by Spanish missionaries after the conquest to locate them were apparently futile.

The Great Temple subsequently was the scene of some stirring and bloody events. In May 1520, after holding the emperor Motecuhzoma (Montezuma) prisoner for more than six months and, in effect, ruling his empire for all this period, Cortés left the city with part of his small army to contend with a much larger, punitive force sent out by the governor of Cuba to arrest him for disobedience in undertaking the conquest on his own initiative. In Veracruz, Cortés surprised and defeated his fellow Spaniards and persuaded them to return with him to the city. In the meantime, however, Pedro de Alvarado, the officer left in charge of the tiny garrison guarding Motecuhzoma, became nervous over rumors of a native uprising. In a preventive act of terrorism he massacred many young nobles who were dancing during a major ceremony in the patio in front of the Great Temple. This precipitated a mass attack on the Spaniards, who had taken over and fortified the palace of Motecuhzoma's father, adjacent to the Great Temple precinct. Alvarado held out until Cortés returned with his considerably augmented force, but soon thereafter the Aztecs greatly intensified their attacks, overrunning the Great Temple and removing the Christian images Cortés had placed there. According to Cortés's own account, 500 crack Aztec warriors ascended the towering structure, from the top of which they inflicted, with their missiles, considerable damage on the besieged Spaniards in the nearby palace. At least twice Cortés sent out flying columns to clear the Great Temple, but each time they were beaten back. Finally, he lashed a shield to his arm to protect his hand (wounded three days before), drew his sword, and personally led another attempt to take the temple. He succeeded after a savage hand-to-hand struggle on the top

Fernando Robles; Mexican National Institute of Anthropology and History

platform, which lasted more than three hours and during which nearly all of the defenders were killed.

Cortés then proceeded to burn and blow up the sanctuaries on top of the Great Temple and apparently those of other temples in the precinct, to emphasize the humiliation of the defeat and to proclaim the superiority of the True Faith. In one account, Motecuhzoma—already wounded when, at Cortés's instance, he had tried to dissuade his people from further attacks on his captors—died in an agony of frustration and despair when he heard the explosion destroying the sanctuaries of his principal gods.

Two days later, on June 30, 1520, the Spaniards were forced to evacuate the city during the night, with heavy losses. They fought their way back to Tlaxcala, a friendly province never conquered by Motecuhzoma, and the following year, after receiving reinforcements and campaigning successfully in the environs of Mexico-Tenochtitlan, the Spaniards besieged the city once again. The Aztecs, under their new emperor, Cuauhtemoc, a young cousin of Motecuhzoma, put up a tenacious, desperate resistance. They had refurbished the Great Temple, but their defense was unsuccessful, as the Spaniards, on the first day of the siege, broke into the sacred precinct with both cavalry and foot soldiers and temporarily recaptured it. It was probably on this occasion, during the ferocious fighting at the gates of the sacred precinct, that Cuauhtemoc and other great lords conducted a ritual atop the Great Temple that may have had a profound effect on the defense of the city. The ruler of nearby Tlacopan, the third city in the Triple Alliance, peered into a divinatory mirror of polished obsidian and, looking up in dismay, cried out to Cuauhtemoc, and the others desperately awaiting his word, that Mexico-Tenochtitlan was lost. Huitzilopochtli, the patron god of the all-conquering Aztecs—who, at the outset of their migration centuries before, had promised them a great destiny—now, in their hour of maximum danger, had turned his face from them.

Dejected, Cuauhtemoc and the other lords descended and managed to escape. Soon thereafter Mexico-Tenochtitlan was essentially abandoned and the idol of Huitzilopochtli was carried to Tlatelolco, the capital's adjacent "twin city," famous for its great market. There the Aztecs made their last stand against the Iberian invaders and their numerous Indian allies. Captured in a canoe trying to escape, Cuauhtemoc formally surrendered his

Left: The discovery of this stone monument, about ten feet in diameter and one foot thick, precipitated the current excavation of the Great Temple. The relief carving depicts Huitzilopochtli's malevolent sister, Coyolxauhqui, who was slain by him. This image of her dismembered corpse was placed at the foot of the stairway that led up to Huitzilopochtli's shrine atop the Great Temple. Below: A stone carving of a conch shell, about three feet long, was one of several larger objects recovered near the Great Temple. A symbol of fertility, it may have been related to the shrine on the Great Temple devoted to the fertility-rain god, Tlaloc.

David Hiser; reproduced with permission of the Mexican National Institute of Anthropology and History

empire to Cortés on August 13, 1521. By this time Mexico-Tenochtitlan and its ceremonial center had been almost completely razed. The Spaniards took particular pains to destroy the Great Temple of Huitzilopochtli and Tlaloc, which was leveled almost to the ground. Where it had stood, house lots were parceled out to deserving conquistadors, while the peripheral areas of the city were resettled by the Indians.

A general notion of the appearance of the Great Temple precinct and the many large structures within it can be gleaned from various texts and pictures. In 1524, Latin translations of the second and third official dispatches of Cortés were published in Nuremberg, Germany. Included with them was a woodcut plan of the Aztec capital and its environs. However quaintly Europeanized, the woodcut was almost certainly based on a plan, since lost, that Cortés had sent to the young emperor. Shown in the center of the city, greatly exaggerated in size, is a simplified, schematic representation of the Great Temple precinct, the first ever to be published. It does not, however, provide a very accurate depiction of the Great Temple of Huitzilopochtli and Tlaloc or the other major temples.

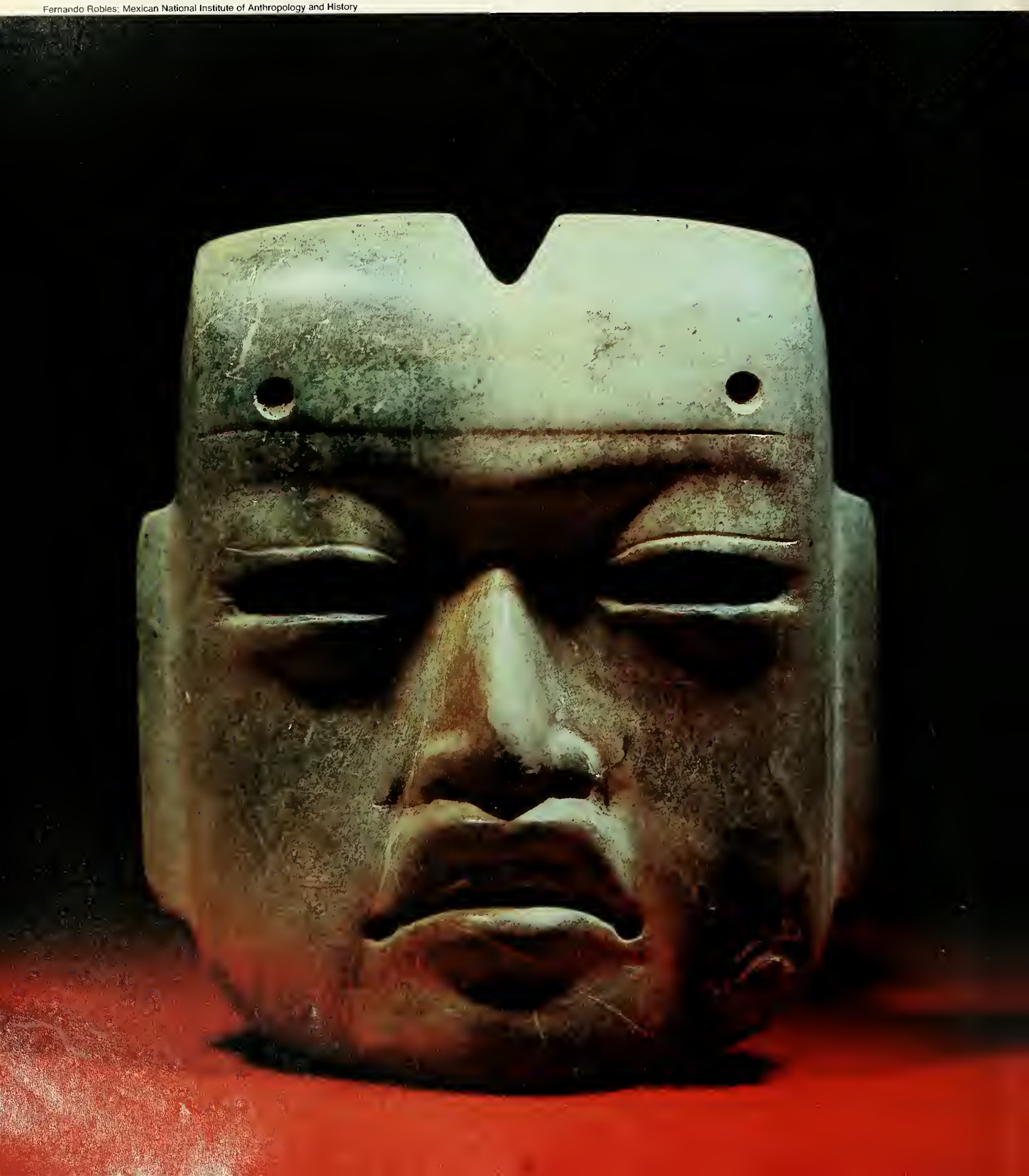
More informative representations can be found in various postconquest pictorials made by natives according to their traditional style. The *Codex Telleriano-Remensis* (ca. 1563) depiction, which shows the Great Temple being dedicated in 1487 after its last major renovation, is quite small and stylized but correctly shows the structure with four tiers, or stages—although the Huitzilopochtli and Tlaloc shrines are reversed. A diagram of a temple precinct in Fray Bernardino de Sahagún's *Primeros Memoriales* (1559–61) is invariably assumed to depict the Great Temple and at least its own enclosure, but it may represent instead the ceremonial precinct of Tepepolco, a town a few miles to the northeast where Sahagún began his researches. In any case, the temple is even more stylized than the *Codex Telleriano-Rememsis* version, with no stages indicated, although the two shrines are correctly positioned. Probably the most accurate idea of what the Great Temple looked like may be obtained from the *Relación de Texcoco* of Juan Bautista Pomar (1582), which depicts the temple of Huitzilopochtli and Tlaloc in Tetzcoco, the second city in the Triple Alliance. This temple was built to replicate the one in the imperial capital across Lake Texcoco. It was dedicated in 1467 by Nezahualcoyotl, the famed "poet-king" and nephew of Motecuhzoma I, the Aztec ruler at the time.

We would have a much better notion of the layout of the structures within the Great Temple precinct had not a detailed plan of it disappeared—one drawn in Mexico (about 1565–69) by the Indians for Fray Bernardino de Sahagún and sent to Spain. A legend of this plan survives, with a detailed itemization of seventy-eight principal structures and other features within the huge ceremonial enclosure, but without the plan itself it is extremely difficult to visualize the nature of the structures listed and the spatial relationships between them.

During the colonial period, which lasted from 1521 to 1821, even the location of the Great Temple gradually faded from memory. The view that gained currency over the years was that its place had been taken by the Cathedral of Mexico, erected from 1573 to 1667. On occasion, major monuments that had once graced the Great Temple precinct or its immediate environs were discovered near the Cathedral, usually as a result of construction activity. In 1790 and 1791, for example, three of the most famous Aztec monuments were unearthed in the city's central plaza: the large, circular Calendar Stone, an intricate representation of the solar disk; the Cuauhxicalli of Tizoc, a ceremonial stone receptacle for sacrificial human hearts; and the gigantic image of Coatlicue, a monstrous version of the mother of Huitzilopochtli. In 1830 a colossal greenstone head of Coyolxauhqui, the sorceress sister of Huitzilopochtli, was found in what had been the south-central portion of the sacred precinct. The current excavations were launched by the discovery, almost 150 years later, of a great relief sculpture of this same personage. Also, sometime before 1846, a greenstone slab was discovered on which was carved the date 8 Acatl (1487), the year of the final major renovation of the Great Temple, and the depictions, with their name signs, of two fifteenth-century Aztec rulers—Tizoc, who began the project, and Ahuitzotl, who finished it. Many more important monuments have since come to light in this same zone.

One of the most unusual objects found in an offertory cache was this stone mask, which is about four inches high. It is carved in the style of the Olmec civilization, which flourished about 1200–300 B.C., long before the Aztec capital was founded in A.D. 1325. It may have been kept as an heirloom and eventually passed on to the Aztecs as tribute.

Fernando Robles; Mexican National Institute of Anthropology and History



Many miniatures were found in the offertory caches of the Great Temple. This three-inch-high covered brazier, carved in stone, is an Aztec-style object.

Fernendo Robles; Mexican National Institute of Anthropology and History

In 1900, a deep sewer line more than two yards across was sliced through the southern portion of the Great Temple itself, although this was not realized at the time. The archeological pieces found in the section of the trench that ran through a street just north of the Cathedral were reported on by Leopoldo Batres, the Mexican government archeologist who supervised the salvage project. In 1901, during nearby construction, a wide, balustraded stairway was discovered, along with a colossal head of the Fire Serpent and a magnificent, huge sculpture of a jaguar, which now greets visitors at the entrance to the Mexica Hall of the National Museum of Anthropology.

In 1912, Alfred P. Maudslay, a productive British student of Mexican and Maya archeology, assembled most of the ethnohistorical data concerning the Great Temple, concluding that it was located not under the Cathedral but a short distance to the northeast. His view was amost immediately confirmed by the accidental uncovering a year later of the southwest corner of the structure. Mexico's leading anthropologist of this period, Manuel Gamio, supervised the excavation of this portion of the Great Temple, revealing a sequence of four construction stages. The results of this work were left exposed, but the time was not yet ripe for a comprehensive excavation of the Great Temple, which would have required the demolition of buildings on the site. In 1933, some excavations conducted in the northeast corner of the Cathedral lot uncovered a balustrade and stairway, which, it is now known, gave access to a great platform on which the Great Temple stood (the sewer line of 1900 had also revealed a portion of this stairway). And some other discoveries were made in and around the Great Temple precinct in later years. The excavation in 1968–69 of the tunnel of Route II of the Mexico City subway revealed various archeological features, including a long platform that might have supported a skull rack. A more important development was the tunneling under the Cathedral and the adjoining Sagrario in 1975–76 to strengthen their foundations. This project enabled a team of Mexican government archeologists, headed by Constanza Vega Sosa, to investigate the area in the southwest corner of the Great Temple precinct. The foundations of various structures were discovered, including two sizable ones under the Sagrario, the larger identified as the Temple of the Sun and the smaller, circular in form, as the Temple of Ehecatl-Quetzalcoatl, the wind-fertility god.

The turning point in the long history of the exploration of the Great Temple occurred, as might be expected, quite accidentally. On the night of February 21, 1978, workers for the Mexico City Light and Power Company, digging a pit for the installation of voltage transformers near the northeast corner of the intersection of Argentina and Guatemala streets, came down directly on a huge oval stone monument. Carved on it in very high relief was a representation of Coyolxauhqui, the malevolent sister of the god Huitzilopochtli. According to myth, Coyolxauhqui conspired with her numerous other brothers to kill their mother, the pious widow Coatlicue, when she was about to give birth to Huitzilopochtli. Reassuring his mother from the womb, Huitzilopochtli sprang forth fully armed and accoutered and proceeded to destroy his assailants, decapitating and dismembering their ringleader, Coyolxauhqui. She was so depicted on the monument, whose discovery caused a sensation in Mexico. A salvage team of Mexican government archeologists, headed by Angel García Cook and Raúl M. Arana Alvarez, carefully exposed the great stone and excavated around it, finding ritual offertory caches and a greenstone slab carved with an image of a fertility goddess. They also found

The excavation of the Great Temple has revealed seven major stages in its construction and renovation, as well as many minor stages. The second major stage, probably dedicated in 1390, was so well preserved beneath subsequent layers of construction that the bases of the two shrines that had once been at the temple's summit were still intact. This photograph shows the southwest corner of the Tlaloc shrine, with the adjacent corner of the Huitzilopochtli shrine to the extreme right. The painted motif of vertical lines may represent rain, appropriate for Tlaloc, the fertility-rain god.

the remnants of another, earlier Coyolxauhqui in stucco at a lower depth. No doubt, the stone monument itself had been concealed by a subsequent renovation and superseded by a later version (which was presumably destroyed at the time of the Spanish conquest).

With the impetus of this spectacular discovery, archeologists at last received the support they needed to carry out a systematic excavation, and in March of 1978, the Great Temple Project, under the direction of Eduardo Matos Moctezuma, was formally initiated. Matos Moctezuma and his large team have worked continually to the present on the excavation and restoration of the Great Temple. The buildings covering it have been demolished, and an extensive area has been cleared, exposing all four of the temple's sides. Seven major stages, plus various minor ones, in the growth of the structure have been revealed. The best preserved of these is the second, for even the lower walls of the Huitzilopochtli and Tlaloc shrines were found intact—as well as a sacrificial stone and a polychrome reclining "Chacmool" figure, which graced their entrances. The Tlaloc shrine displays remnants of wall paintings, featuring both abstract and representational motifs.

Correlating the numerous construction stages of the Great Temple with the various renovations described in the ethnohistorical sources has posed considerable problems. The recent excavations have revealed three, possibly four, stone plaques with native-style dates. These might have been laid in dedication of the second, third, and fourth major stages of construction, and a subsequent, lesser addition (called IV B), possibly in the years 1390, 1431, 1454, and 1469. Unfortunately, in addition to presenting other problems of interpretation, none of these stone plaques contains any additional representations that could be chronologically relevant, such as depictions or the name signs of historically documented rulers. Such connections are important because Aztec dates are cyclical, the same date recurring every 52 years. For example, we can be sure that the large greenstone plaque mentioned earlier was the 1487 dedication stone of the final major renovation because it contains the portraits and name signs of the rulers Tizoc and Ahuitzotl.

The Coyolxauhqui monument, whose discovery sparked the current excavation of the Great Temple, proves to have been part of the stage IV B construction. It was set into the plaster surface of the massive platform on which the temple rested, at the bottom of the southern stairway, which led up to the Huitzilopochtli shrine. Projecting from the bases of the stairway's balustrades are two colossal feathered serpent heads (one discovered by Gamio in 1913). The northern stairway, which led up to the Tlaloc shrine, was similarly ornamented with giant snake heads of a different style. The western edge of the great platform features a wide stairway flanked by colossal undulating serpents. A platform projects out from that part of the stairway that fronts the Tlaloc temple; on it are set two large stone frogs with holes in their backs for the insertion of poles topped with banners. The western edge of a later gigantic platform, decorated with protruding stone snake heads, aligns almost exactly with the row of modern buildings on the west side of Argentina Street—which prevents further excavation in this direction.

North of this final massive platform are three small structures in an east–west line. The westernmost has stairways on both its western and eastern sides. The central one is decorated on three of its sides with panels of massed stone skulls, 240 in all. The easternmost, decorated with abstract painted motifs in red—and dubbed, accordingly, the Red Temple—is balanced on the south side of the great platform by an identical structure. On the northern edge of the excavated area are some platform structures with wide stairways. Stone eagle heads project from the upper balustrades of one of these, and this structure, consequently, has been designated the Temple of the Eagles. Adjacent to this building is a complex of rooms that is now being excavated. Some of these chambers are edged with stone benches decorated with polychromed relief carvings of marching warriors. Interestingly, this feature is particularly typical of the pre-Aztec site of Tula—evidence of the debt the Aztecs owed to their revered cultural and political predecessors, the Toltecs.

Apart from the great Coyolxauhqui monument, the most spectacular discoveries during the Great Temple Project have been of pieces contained in the numerous ritual offertory caches. These have provided a remarkable variety of objects, including a large number of stone images and masks, many of them in non-Aztec styles. The rather abstract style known as "Mezcala,"centered in the modern southwestern state of Guerrero, is particularly well represented. Other types of material found in the caches include: stone vessels, often with Tlaloc faces; ceramic vessels, many in effigy form; numerous marine shells and ornaments and other objects of carved shell; sacrificial stone knives and other lithic artifacts, some in shaped obsidian; human skulls, some decorated with shell- and hematite-inlaid eyes and sacrificial knives inserted in the nasal apertures; animal skeletons; and a few gold, silver, and copper ornaments. One of the most unexpected discoveries in one of the caches was a stone mask in the style of America's first civilization, the Olmec, which flourished from about 1200 to 300 B.C. in the Gulf Coast region. Stone masks in the style of Teotihuacan, the great city of the Classic period (ca. A.D. 100–750) located about twenty-five miles northeast of Mexico City, were also found in caches.

Aside from the already mentioned Coyolxauhqui monument and the greenstone fertility goddess slab, a few important stone sculptures have been found. Among them is a large image of the fire god that, fascinatingly, combines Teotihuacan and Aztec style and iconography; a colossal conch shell; and a striking head of an eagle with an elaborate knotted headdress. In addition, eight archaic-style anthropomorphic stone images were found at the base of the southern stairway, apparently deposited there when the fourth major stage of construction occurred, completely covering over the earlier structures. The figures, most of which had probably served as standard bearers on the summit of the earlier temple, were evidently taken down and deliberately buried

Fernando Robles; Mexican National Institute of Anthropology and History

at the time of the renovation. Their relative crudity shows that a tremendous advance was made in the development of Aztec-style stone sculpture by the time of the conquest.

The basic significance and function of the Great Temple, positioned in the middle of the large ceremonial enclosure of the city, seems reasonably clear. It constituted an intensely sacred focal point for what was the most extensive empire to exist in North America before the coming of the Europeans. In their official ideology, the inhabitants of the imperial capital believed that they had, at the outset of their history, established a kind of covenant with their patron deity, Huitzilopochtli. In exchange for obeying his commandments, delivered through his priests, and for recognizing his supernatural preeminence, he had promised them a special destiny as the masters of a great empire. They had succeeded beyond all expectations and in his honor had erected this huge temple, which served both as the central locus for his cult and as a commemoration of the myth of his birth.

Huitzilopochtli's extraordinary birth was briefly described above, in connection with the giant carving of his sorceress sister, Coyolxauhqui. There are other details of the myth that have special relevance to the structure of the Great Temple. After a miraculous conception, his mother, Coatlicue, or "Serpent Skirt," gave birth to Huitzilopochtli on Coatepec, or "Serpent Mountain." This was supposedly a stopping place on the migration route of the Aztecs (before they settled in Mexico-Tenochtitlan), and the Great Temple bore precisely this name. Wielding his magic weapon the Fire Serpent, Huitzilopochtli decapitated and dismembered his evil sorceress sister, hurling her down the mountain—and Coyolxauhqui is so portrayed, appropriately situated at the foot of the stairway leading up to the shrine of her victorious brother. Her colossal, severed stone head, found in 1830, probably rested on one of the stages of the towering structure. During the "Raising of Banners," an annual ceremony especially dedicated to Huitzilopochtli, ritual combats reenacted his struggle with his equally hostile brothers, the "Four Hundred [innumerable] Southerners." At this ceremony, a large paper image of the Fire Serpent—the weapon he also used to destroy them—was brought down from the top of the Serpent Mountain and burned. Following this, a number of victims, both war prisoners and slaves purchased by the merchants for this purpose, were sacrificed.

The usual interpretation of the myth of Huitzilopochtli's birth is that he represents the sun, born each day from his mother, Coatlicue, the earth; he "slays" the moon, his sister, Coyolxauhqui; and disperses the stars, his innumerable brothers, of the southern firmament. Whether or not this interpretation is entirely valid, Huitzilopochtli undeniably had strong solar associations, and Coyolxauhqui was intimately related to a complex cluster of earth-fertility goddesses whose lunar associations have long been accepted.

As has been mentioned, Huitzilopochtli shared his place of honor atop the Great Temple with the deity Tlaloc. This god, who controlled the rain on which all life on earth depended, was one of the most ancient and important in pre-Hispanic central Mexico. Tlaloc shrines were characteristically located on the summits of hills. Although it is not mentioned in the myth, it might have been believed that a Tlaloc sanctuary had been located on the crest of Coatepec, the birthplace of Huitzilopochtli. This might account for the presence of such a shrine on the Great Temple—which replicated the Serpent Mountain. On the other hand, Tlaloc's tremendous importance in Aztec cult and ritual may be sufficient explanation for his place on the summit of the most sacred temple in the empire. It is also possible that a cosmic contrast—a typically Mesoamerican ideological pattern—may have been involved. The personage of Tlaloc, symbolizing the fertility of the earth produced by his bounty of life-giving rain, may have complemented Huitzilopochtli, a celestial deity with solar connotations, one of whose names was Blue Sky, and who symbolized the incessant warfare and consequent death by sacrifice that was considered necessary to sustain the universe.

The current excavations have already provided various new insights concerning the Great Temple and Aztec ceremonial practices in general. For example, it is now clear that earlier hypothetical reconstructions of the size of the Huitzilopochtli and Tlaloc temple were at least a third too large—including that by the Mexican architect and archeologist Ignacio Marquina, which provided the basis for the large model of the Great Temple precinct now exhibited in the Mexica Hall of the National Museum of Anthropology. Also, although in general layout and form the temple conforms closely to its descriptions in the ethnohistorical sources, many previously unknown features have been revealed, such as the early Chacmool image, the sequence of Coyolxauhqui sculptures, the massive size of the successive platforms on which the temple stood, the adjoining structures on the north and south, and, above all, the extraordinary number of offertory caches. The richness and variety of the objects encountered in these caches were a considerable surprise, particularly the amount of material, stylistically non-Aztec, which came from distant provinces of the empire located in the modern states of Guerrero, Puebla, Oaxaca, and Veracruz. The Aztecs' deposition of offertory caches in and adjacent to their temples, especially in connection with the constant renovations of these sacred structures, constituted a more important aspect of their ritual than was earlier suspected.

The Great Temple Project continues, having begun four years ago with a chance discovery in the middle of the night, at a busy intersection in the heart of one of the largest cities of the world. Many more important and interesting discoveries can be anticipated, even as some of the most significant finds are being displayed and exhibition catalogs and preliminary reports are being published. When the project is completed, the Great Temple site will be opened to the public as an archeological park, with an adjoining museum in which the most important pieces found during the excavations will be on view. ☐

Moving

Please give us 8 weeks notice. Attach your label and print your new address below.

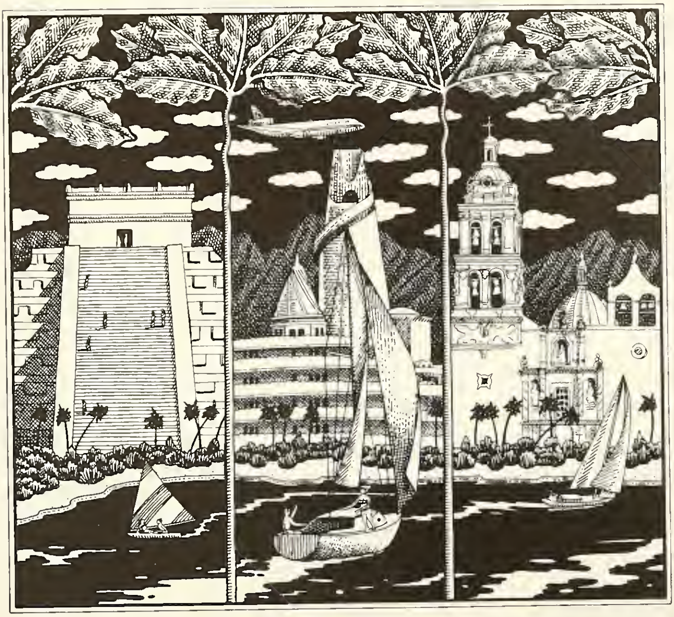
NATURAL HISTORY
P.O. Box 4300, Bergenfield, N.J. 07621

PLEASE PRINT
Name
New Address
City
State
Zip

PLEASE ATTACH MAILING LABEL
Name
Address
City
State
Zip

Aeromexico Gives Wings to Your Dreams™

Take a Safari in Mexico.



17 fascinating days through Mexico City and the exciting Yucatan. IT2AM1MT33

$1,969.00

Includes hotels, meal plan, ground transportation and transfers; does not include airfare.

You won't be going after wild animals on this safari, but you will be hunting down the big game of Mexico's fascinating and colorful culture.

Begin your adventure in Mexico City. Explore the treasures of the world-famous Museum of Anthropology, witness the inspiring Shrine of Guadalupe and marvel at the majesty of the Pyramids of the Sun and Moon where Mexico's ancient Indian civilizations commanded their empires.

Plus you'll have lots of time to wander about the Lagunilla Market. With the dollar now stronger than ever in Mexico, you're sure to find incomparable shopping values.

Then it's off to the Yucatan, with its lush, untouched landscape, old-world villages and mysterious ruins. Journey through places whose names themselves conjure images of adventure.

It's all first-class hotels in this odyssey of a lifetime with Aeromexico's Amazing Mexico City/Yucatan Safari. For more information, send for a free brochure, or see the Mexico Expert, your Travel Agent.

Price per person, double occupancy, subject to change.

aeroméxico

Please send your brochure describing Aeromexico's Amazing Safari.

aeromexico
Dream Vacation Center™
P.O. Box 661565
Miami, FL 33166

Name
Address
City
State
Zip
Travel Agent

NH-7/82

Encounters of the Galactic Kind

In slow encounters, galaxies can be gobbled up. In fast encounters, they can be stripped

by Douglas Richstone

Galaxies are vast aggregations of stars, gas, dust, and empty space distributed throughout the universe. There are about ten million galaxies within the optical range of the largest earthbound telescopes, each of which typically contains billions of stars held together by the gravitational attraction of one member star for another.

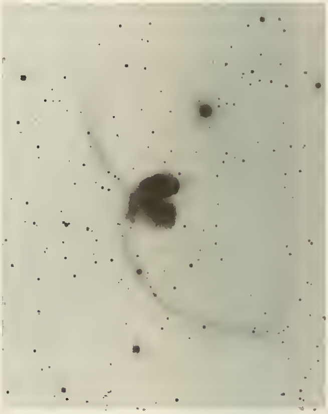
Two major types of galaxies—and several minor ones—were initially recognized by the astronomer Edwin Hubble in the 1920s. The spirals, the most numerous type, have a pinwheel structure of very luminous stars, gas, and dust superimposed on a disk (a thin, pancakelike structure) of fainter stars. About 45 percent of known galaxies, including our own Milky Way, are spirals. The second major type is the ellipticals, which have the outline of a flattened circle. About 25 percent of galaxies are ellipticals. (The other galactic varieties originally noted by Hubble were the barred spirals and irregular galaxies.)

Since Hubble's time, descriptions of the types of galaxies have steadily improved, as has our understanding of the motions of the stars within the galaxies. Nevertheless, we still have only the vaguest idea of how the galaxies are formed and why some of them are spirals and some ellipticals. For the last few decades astronomers have felt that galaxies were formed more or less in the shapes in which they are now seen. Recently, however, a few astronomers have argued that not all types of galaxies were initially formed as they are currently seen; rather, some of the ellipticals may evolve from spirals by a process of cannibalism.

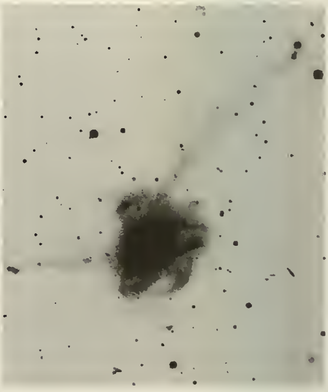
More than 99 percent of the material in elliptical galaxies is in the form of stars, while in large spirals the proportion is about 90 percent. Much of this material may be in the form of very low-mass stars or planet-sized objects that produce little light. If our galaxy were modeled by reducing its stars to the size of pennies, those near our sun would be separated from one another by about 500 miles, and 100 billion pennies would be spread out over a region of space at least ten million miles across. Despite these distances, our galaxy, and all others, are held together by the mutual gravitational attraction of the stars for one another. Stars in the disk of the galaxy, such as our sun, orbit the center in approximately circular paths, much as the earth orbits around the sun—except that our sun travels at a speed of about a half million miles per hour, or about ten times as fast as the earth moves. Even at that rate, it takes the sun about 200 million years to complete one of its vast orbits. It has gone around the Milky Way galaxy only about twenty-five times since the galaxy was formed some ten to twenty billion years ago.

Galaxies are not homogeneously distributed in space but are themselves clustered into larger aggregates that vary in size from a few galaxies to several hundred. Like the stars within the galaxies, these galactic clusters are held together by the mutual gravitational attraction of the member galaxies to one another. The distance from the sun to its nearest neighboring star in our galaxy is about 100 million times the diameter of the sun, which is approximately 880,000 miles. The sun would have to be very accurately aimed to strike that neighbor (the equivalent of firing a gun in Los Angeles and hitting a penny in San Francisco). That the sun will strike any other star in our galaxy during the next ten billion years is extremely unlikely.

In dense galaxy clusters, however, the typical galaxy size is about 60,000 light-years (one light-year is approximately 6,000,000,000,000 miles) while the typical distance between galaxies is about four times larger. Although this distance seems immense, the member galaxies in a cluster are, on a cosmic scale, relatively close together. Just as the sun moves in response



During a slow encounter this pair of galaxies, NGC 4038 (top) and NGC 4039, ejected two plumes of stars that resemble some insect antennae.



Galaxy NGC 7252 also has plumes of stars thought to have resulted from an earlier encounter between two galaxies.

Photographs from Cerro Tololo Inter-American Observatory to the gravitational pull of all of the other stars in our galaxy, the galaxies within a cluster move in response to the pull of the other galaxies. Because the galaxies are so closely spaced relative to their sizes, the chance of a galactic encounter is great. Galaxies in dense clusters have run into each other in their past ten billion years of life and will inevitably continue to do so in the future.

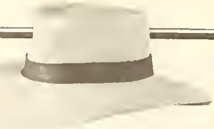
But just as the sun is unlikely to strike other stars in our galaxy, so the stars in one galaxy are unlikely to strike any of the stars in another galaxy when two galaxies within a cluster meet. Instead, the two galaxies simply pass through each other with the individual stars undamaged. The galaxies themselves, however, are not unscathed. Although the stars do not touch each other in such encounters, they do interact through their gravitational attraction. And as an individual star in a galaxy moves in response to the gravitational attraction of the other stars within its galaxy, during encounters between galaxies a star in one galaxy responds to the gravitational pull of the stars in the other galaxy. If the second galaxy passes very close to the first or moves by relatively slowly, the deflection may be very large. Stars nearest the passing galaxy are affected much more strongly than those farthest away. The situation is similar to tides raised in the oceans by the moon. But in galaxies that pass each other, the forces exerted on a star from the nonparent galaxy can be as strong as those exerted by the parent galaxy. In a slow encounter, these forces can pull vast plumes of stars out of both galaxies.

About ten years ago some astronomers devised a scenario for what might happen in a slow encounter between two galaxies in the same cluster. Calculating the motions of the stars in the modeled galaxies during such encounters, they produced computer-generated plots of several pairs of peculiarly shaped galaxies with plumes. These computer plots resembled photographs of actual galaxies, NGC 4038 and NGC 4039, discovered in 1923. This pair of galaxies is sometimes referred to as "the antennae," because its plumes resemble the antennae of various insects.

The same gravitational forces that raise these plumes of stars in the computer models also reduce the relative velocities of the galaxies enough to prevent them from escaping from each other. Their mutual gravitational attraction pulls them back together and they encounter each other again and again. These slow encounters are likely to occur in small clusters of galaxies containing only a few members. The second encounter of the now bound pair of galaxies will be slower than the first and therefore more damaging. Successive encounters are insured until the smaller of the two galaxies is either broken up or swallowed whole.

Recently a real galaxy that is almost certainly a product of this sort of galactic interaction—or cannibalism—has been found and extensively studied. A photograph that emphasizes the outer regions of this galaxy, designated NGC 7252, shows two large plumes. According to computer modeling, these may once have had the appearance of the plumes in the previously mentioned galaxies, NGC 4038 and NGC 4039. Shorter exposure photographs reveal that the central part of NGC 7252 contains at least two concentrations of light. Spectra of these condensations show (via the Doppler effect) that the center of the galaxy rotates in a different direction from the outer parts. One can easily imagine that this system is an intermediate stage in the merger process, that is, these were once two galaxies that have incompletely coalesced and whose plumes are not yet completely dissipated. It is difficult to think of an acceptable alternative to this explanation for objects such as NGC 7252.

The observations of NGC 7252 rein-



PLANTER'S SUN HAT

The hat made famous by riverboat gamblers and planters in the Old South. Cool and breathable cotton duck gives relief from summer sun. The broad and flexible brim lets you control the degree of shade. Genuine leather hatband. Sized to fit men and women. **Color:** Cream. **Sizes:** S(6⅞-7), M(7⅛-7¼), L(7⅜-7½), XL (7⅝-7¾). **$16.95** postpaid.

Order Today! Money Back Guarantee!

Here is my check or money order for $________ (Add sales tax for shipment into CA, CO, D.C., IL, MI, PA, WA).

☐ MC ☐ VISA ☐ AMEX

Card No. ________ Exp. Date________

RUSH my **#1954 Planter's Hat.** Size______

Name ________

Address ________

City ________

State ________ Zip________

☐ **Send me your FREE color catalog of quality outdoor apparel and equipment.**

Eddie Bauer®

Dept. BNH, Fifth & Union, Seattle, WA 98124

LEARN PROFESSIONAL PHOTOGRAPHY at home.

Would you like to see your pictures in magazines like this? For 70 years, NYI has trained amateurs to take professional pictures—pictures that get published, win prizes, even lead to a new career. If you love photography, NYI can make it happen for you too.

You'll learn at home in your spare time, with our new "Voice-on-Tape" method that guides you easily through magnificent portfolio-size lessons, illustrated by salon-quality photos of world-famous masters. A remarkable course at surprisingly low cost. Call or send for free informative booklet. No obligation.

Mail coupon OR CALL TOLL FREE 800-453-9000

Yes! Send me the free color booklet about the NYI Course. No obligation. No salesman will call.

Name ________

Address ________

City/State/Zip ________

☐ Under 18, check here for special information.

New York Institute of Photography

Dept. N72 880 Third Ave., N.Y., N.Y. 10022

force the theory of close galactic encounters, which indicates that, in general, galactic cannibalism depends on the speeds at which galaxies are moving relative to each other. If the galaxies are moving at more than three times the speed at which their individual stars are orbiting, they will pass through each other without any cannibalism. On the other hand, if one or the other galaxy is moving at twice or less the speed of its orbiting stars, that galaxy will be gobbled up.

The examples of slow galaxy encounters described above, those in which the galaxies are moving at about one million miles per hour, are typical of the phenomena that occur in groups of galaxies composed of a small number of members. In the richest clusters of galaxies, those containing hundreds of members, the galaxies are usually moving fast and encounter each other while traveling at about 4 million miles per hour. Even at those speeds it takes two good-sized galaxies 50 million years to pass through each other. During that time the galaxies *do* raise plumes of stars, and stars are stripped off into space, but the galaxies are moving too quickly to be slowed down appreciably. However, a small fraction of members in the rich and otherwise fast-moving galaxy clusters travel at velocities near one million miles per hour rather than the more usual 4 million miles per hour. Encounters between these relatively slow-moving galaxies *can* slow them down appreciably and may result in a merger if at least one of the two galaxies is sufficiently massive. Nevertheless, in most large clusters only 10 percent or less of the member galaxies are likely to be involved in a merger. Mergers in otherwise fast-moving galaxies might not have even been noticed were it not for a spectacular set of phenomena associated with the brightest galaxy in the few galactic clusters currently under study.

In about 10 percent of the denser clusters of galaxies a remarkably bright and unusually large and diffuse elliptical galaxy is centrally located. The uniqueness of these ellipticals was recognized less than two decades ago but their detailed structure has now been mapped out. These galaxies shine with the light of at least 1,000 billion suns; they are ten to twenty times brighter than the normal bright elliptical galaxy. They are not as concentrated as normal ellipticals and an unusually large fraction of the light radiating from them comes from stars that are far from the galactic center. Ten galaxies the size of our own Milky Way would fit end to end within one of these giants.

In many cases these galaxies, unlike ordinary ellipticals, have more than one nucleus. In the early 1970s, Jeremiah P. Ostriker and Scott Tremaine (then both at Princeton University) suggested that these supergiant elliptical galaxies were initially formed by the merger of two or more of the heavier galaxies in the cluster. In their theory, as the supergiant grows in size, it becomes easier for it to stop other galaxies as they pass through it. This is galactic "cannibalism" on a grand scale. The captive galaxies contribute their light to the total aggregate, once they are digested, and the process accordingly produces a very large, massive, luminous galaxy. The galactic encounters slow the heavier galaxy, so it settles to the cluster center. Since breaking up the nucleus of a galaxy takes longer than shearing off the loosely bound stars on the outskirts, multiple nuclei sometimes result.

A different process takes place in the more typical fast-moving, large galaxy clusters. Stars from galaxies in the cluster that are not directly involved in the encounter are nevertheless stripped off to produce a diffuse star cloud that is even larger than the giant galaxy itself. Detailed numerical simulations of these two processes—cannibalism in slow encounters and stripping in speedy ones—have been carried out. These calculations show that both processes can produce a supergiant galaxy with the observed characteristic large size and central location in a cluster.

By far the best evidence of galactic cannibalism in clusters is obtained, not by comparing the properties of supergiant galaxies with detailed calculations of what they ought to look like, but rather by catching a galaxy in the act. One galaxy that fits the bill is in Zwicky's cluster 027+352 (discovered in the 1950s), which has been surprised at the dinner table. The largest galaxy in this cluster has about six to eight nuclei that probably came originally from different galaxies. The time it will take for those nuclei to coalesce will be only about one billion years (about one-tenth the age of the original galaxies and a relatively short time on the galactic scale). After the coalescence is completed, cluster 027+352 will probably look a lot like a typical supergiant galaxy with a single nucleus.

Most of the spectacular and convincing examples of galactic encounters and cannibalism observed thus far are about one billion light-years distant. They have been found in the rare supergiant elliptical galaxies in clusters or in the slow collisions that we happen to have observed serendipitously. But there may be cannibals close at hand. Our nearest large neighbor, the Great Nebula in Andromeda (which can be seen with the naked eye high in the sky on dark early autumn nights), has two smaller companions. Although small, these companion galaxies each contain about one billion stars. Various arguments indicate that the true extent of the Andromeda nebula is larger than it seems in most photographs, so that the two small galaxies that appear to be well separated are in fact now plowing through the nebula's faint outer regions. The gravitational attraction between the small galaxies and Andromeda's nearby stars produces a wake that slows down the small galaxies, causing them to spiral toward the center of the large galaxy. Before they reach the center, the small galaxies will be broken apart and gobbled up by the gravitational force of the large Andromeda nebula and their light will thereafter contribute to the round part, or bulge, of the nebula.

Even our own galaxy has two small nearby companions that appear to be in danger of the same fate. Many astronomers believe that the Large and Small Magellanic Clouds (spectacular objects visible only from the Southern Hemisphere) are now on their last pass before breakup. In fact, the existence of *two* clouds may indicate that the breakup process has already begun. This cannibalism of dwarf galaxies by medium-sized and large ones may be rather common. Therefore, instead of thinking of galaxies as island universes, we should probably think of them as members of a cosmic ecosystem.

One of the fascinating ramifications of this realization is a possible resolution of an old problem in the structure of our own and some other galaxies. The problem is that the central region, or core, of a galaxy appears to be much denser than the rest of the galaxy—a phenomenon hard to reproduce in the calculations of galaxy formation and evolution that have been conducted. This core could have been formed as a result of the accretion of a very dense (and therefore indigestible) dwarf galaxy that settled more or less intact to the center. Whether most galaxies have dense cores is a question that will probably not be resolved until the launch of the space telescope (a 95-inch telescope in an orbiting unmanned satellite to be carried aloft by the space shuttle in the mid-1980s). And whether the accretion of dense clusters is important in producing those cores will probably be disputed for a long time after that. But the possibility remains that all galaxies are cannibals—at the core.

Douglas Richstone is assistant professor of astronomy at the University of Michigan, Ann Arbor.

An original sculpture in fine, hand-painted porcelain . . .

The Tiger Swallowtail

by Ian D. Loe

A distinguished artist creates a butterfly sculpture of rare beauty.

Life-size-in a natural setting – and in a single, limited edition, at the very attractive price of $95.

Butterflies . . . children of the rainbow . . . are, without a doubt, the most beautiful and most graceful of all living creatures. And of all the different kinds of butterflies that roam the world, none is more extravagantly lovely than the Tiger Swallowtail.

Now, the beauty and the charm of this entrancing butterfly have been captured in a spectacular new and original work of art, executed in a medium that is greatly treasured by collectors—fine, hand-painted porcelain.

This is the work of Ian D. Loe, an artist whose outstanding paintings and drawings of butterflies have won him an international reputation. Loe has portrayed the Tiger Swallowtail, the most familiar of all American butterflies, in a natural setting—resting gracefully upon a sprig of dogwood. The saffron yellow of its wings, with their black velvety stripes, hints of blue, and scalloped crescents of yellow and orange . . . the delicate antennae . . . even the eyes, so tiny yet so bright . . . all are depicted with precise realism, in authentic natural color.

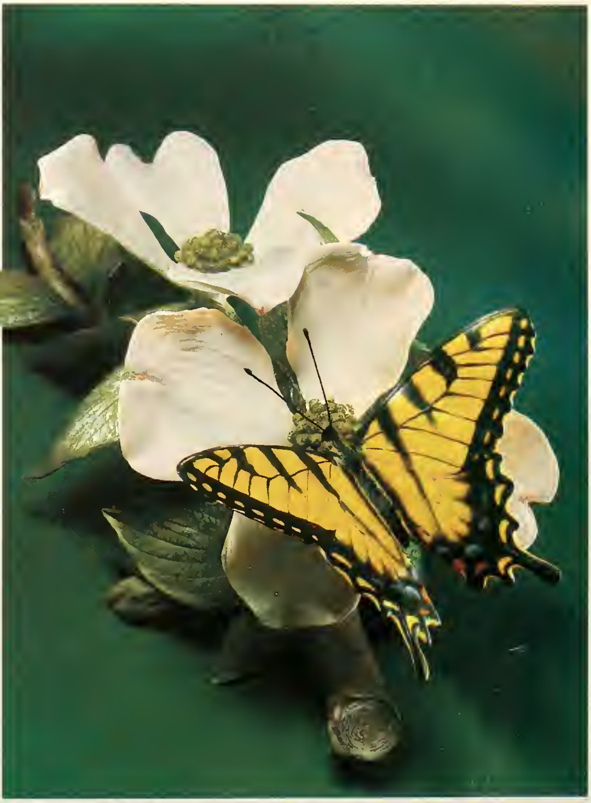
The Tiger Swallowtail will be sculptured *life-size* in this delightful work of art, and will be produced for Franklin Porcelain in Taiwan—home of some of the world's most gifted porcelain craftsmen. And the work will be issued at the modest price of $95—which may be paid in three convenient monthly installments.

In the tradition of classic works in fine porcelain, The Tiger Swallowtail will be made available in a single, limited edition, reserved *exclusively* for those who place orders during the period between now and the end of 1983.

Here is a work that will provide a fascinating focal point of beauty for your home. And will become a treasured heirloom in your family, to be passed along with pride for generations. To reserve it, please be sure that your Reservation Application is postmarked by July 31, 1982.

OUR PROMISE TO YOU

We at Franklin Porcelain take pride in our high standards of craftsmanship. But we believe that our efforts should also be judged by the people we serve. Any work acquired from us may be returned for any reason within thirty days for your choice of replacement or a full refund.



Sculpture shown smaller than life-size Actual size: approximately 3½" wide by 6¾" deep by 3¼" high.

© 1982 FP

RESERVATION APPLICATION

The Tiger Swallowtail

A Limited Edition

Valid only if postmarked by July 31, 1982.
Limit: One per collector.

Franklin Porcelain
Franklin Center, Pennsylvania 19091

Please accept my reservation for The Tiger Swallowtail, by Ian D. Loe, to be handcrafted for me in the finest hand-painted porcelain, at the original issue price of just $95.* plus $2.50 for shipping and handling.

I need send no money now. I understand that I will be billed in three equal monthly installments of $32.50* each, with the first installment due when my sculpture is ready to be sent to me. **Plus my state sales tax.*

Signature ____________________

ALL ORDERS ARE SUBJECT TO ACCEPTANCE

Mr./Mrs./Miss ____________________

PLEASE PRINT CLEARLY

Address ____________________

City, State, Zip ____________________

THE MARKET

Art

AMERICAN INDIAN CRAFTS: Southwest Indian pottery, baskets, rugs, kachinas. Northwest Coast Indian masks, totems, graphics. Eskimo sculpture. No catalog One-of-a-kind pieces, individually photographed. Priced $100/up. Photos and data available. Specify interests. Box 5896. Sherman Oaks, CA 91413. (213) 789-2559

MEXICAN PRIMITIVE PAINTINGS on 'bark' paper, Pre-hispanic process; intricately depicting scenes of village life; approx. 23" × 15½", $35.00 ea. La Tienda, 2358 N Main, Fort Worth, TX 76106

ORIGINAL NIGERIAN BATIKS, Haitian Paintings/Carvings. Pictures Available. Ife International, 73 Elmore Avenue, Englewood, NJ 07631

PRE-COLUMBIAN COLLECTIBLES

GODDESS OF THE NEW MOON: AT'ACTANI—one of many splendid Mayan rubbings/serigraphs! Full-color catalog $2.00 (refundable first purchase).

BERNARDO
2400 Westheimer Road
Suite 108 West (NH4)
Houston, Texas 77098

STONE CARVINGS, Iroquois, $150 and up, request photos, McCoy Imports, Cold Spring Road, Liberty, NY 12754

THE GOLDEN AGE OF NAVAJO WEAVING IS NOW Brochure and descriptive price list of our fine contemporary Navajo rugs and tapestries, $2.00. Guards' Navajo Rugs, 2625 Desert Drive, Las Cruces, NM 88001 (505) 526-3831

WORLD-FAMOUS POSTER ART! Affordable recreations Catalogue $1 . . . refundable with order. Posters, Box 573-N1, Hicksville, NY 11802

Back Numbers

NATIONAL GEOGRAPHICS 1888-1982, issues Book Publications, Collectors Items, Send Wants Buxbaum Geographics, Box 465-NH, Wilmington DE 19899

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHS, 84 Fifth Avenue, New York, NY 10011

Books

BOOKFINDING. Librarians search worldwide titles or subjects plus 150,000 indexed stock. PAB, 2918 Atlantic, Atlantic City, NJ 08401 (609) 344-1943

ORNITHOLOGICAL books, scarce, out of print, rare. Natural history color plate. Catalogues $2.00. Book Chest, 19N Oxford Place, Rockville Centre, NY 11570

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalogue: Hamilton's, 98-55 Clapboard, Danbury, CT 06810

TRAVEL, ADVENTURE, AND EXPLORATION books. The usual and the unusual. Free catalogue from The Armchair Explorer, Dept. NH, 333 Bellam Blvd., San Rafael, CA 94901

YESTERDAY'S BOOKS LOCATED, no obligation. Out-of-State Book Service, Box 3253J, San Clemente, CA 92672 (714) 492-2976

Correspondence

INTERNATIONAL PEN FRIENDS—81,000 members in 143 countries. Write: IPF, Box 65, Brooklyn, NY 11229

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin, West Germany

PENFRIENDS-ENGLAND-USA. Make lasting friendships through correspondence. Send age, interests. Free reply. Harmony, Box 89NH, Brooklyn, NY 11235

SINGLE BOOKLOVERS gets cultured persons acquainted. Nationwide. Established 1970. Write Box AE, Swarthmore, PA 19081 or call (215) 566-2132

Education

FIELD COURSES IN NATURAL HISTORY. College credit. Write Aspen Center for Environmental Studies, Box 8777A, Aspen, CO 81612

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest Handbook, $2.00 (guaranteed). Australian International, Box 19107-RT, Washington, DC 20036

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RT, Washington, DC 20036

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . . Intermountain 4Y, 3506 Birch, Cheyenne, WY 82001

TEACH HERE—TEACH ABROAD: School, College openings: USA $5.95; Abroad $5.95. Placement sources: USA $4.95; Abroad $4.95. EISF, Box 662, Newton, Massachusetts 02162

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Britain. Sampler: 4/$2.98. Free Brochure. Multinewspapers, Box DE-207, Dana Point, California 92629

Government Surplus

GOVERNMENT SURPLUS! Millions of items (Including Jeeps) . . . low as 1¢ on dollar! Most complete Directory available—$2.00. Disposal, Box 19107-RT, Washington, DC 20036

JEEPS, CARS, pickups from $35. Available at local Government Auctions. For Directory call (805) 687-6000 Extension 910. Call refundable

Merchandise/Gifts

AMERICAN INDIAN made Arts and Crafts: Custom name plate, silver w/turquoise with name and title $45. Sand painting desk name plate $32. Each item individually crafted. Free brochure. Custom Enterprises, Box 2997, Gallup, NM 87301. Check, Money Order, Visa or Mastercharge.

BELT SET, $7.50. Interchangeable solid brass, military style belt buckle, engraved with your initials, and any four 1¼", brass tipped cotton webs: khaki, brown, black, navy, natural, white, fatigue green. State colors, waist size, initials. Include $1.00 for postage. A&D Engraving, P.O. Box 640, Utica, NY 13503

GORILLA SKULL, lions, apes, human skulls. Museum quality reproductions. Inexpensive. Send for free catalogue. SKULLduggery, Box 1021-NH, Brea, CA 92621

UNSURPASSED AQUARIUM FISH mailed Filters. Plants. -25%. Catalogue 50¢ (Refundable). (313) 627-2877. Aquadiscount, 33561 Mill, Ortonville, MI 48462

Music

OCARINA—Handcrafted, attractive pendant. Genuine musical instrument with flutelike tone. Free Brochure: Handverks, Sister Bay, WI 54234-143B

RECORDS-TAPES! Discounts to 73%. All labels; no purchase obligations; newsletter, discount dividend certificates. 100% guarantees. Free details. Discount Music Club, 650 Main Street, P.O. Box 2000, Dept. 25-0782, New Rochelle, NY 10801

Optical

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON. Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired Large stock. Orders filled postpaid day received. Birding, Box 5N, Amsterdam, NY 12010

OPTIC DISCOUNTS: Binoculars—Telescopes—Brand Names. Free List. Thos. Manetta, Box 12, 61 Hoffman Ave., Elmont, NY 11003

Personals

MEET SINGLES Mexico, Orient, Europe, Australia Free information. Write: International, Box 1716-NH, Chula Vista, CA 92012

Real Estate

FREE! BIG SUMMER CATALOGUE! Over 5,400 country properties described, pictured! Land, farms, homes, businesses, recreation, retirement values! Selected Best of hundreds of offices All Across America! Strout Realty, Inc., Executive Park Tower, Dept. 5390, Albany, NY 12203. Toll free: 1-800-641-4266; In Missouri call collect: (417) 862-4402

FREE CATALOGUE. Describes and pictures farms, ranches, acreages, businesses and town and country homes from coast to coast. United Farm Agency, Inc., 612-U W. 47th St., Kansas City MO 64112. Call Toll-Free: 1-800-821-2599; MO res. call Toll-Free: 1-800-892-5785

GOVERNMENT LANDS . . . FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00. Lands, Box 19107-RT, Washington, DC 20036

Rentals

NEW JERSEY SHORE Victorian Guest House. Lovely beach. Apartments, efficiencies, rooms. Moderate rates. Good transportation to Manhattan. Cordova, 26 Webb, Ocean Grove, NJ (201) 774-3084

UNCROWDED TEXAS BEACH, 2 hours from Houston, only condo on Matagorda Peninsula, right on Gulf across from Colorado River, great fishing and birdwatching. Write 2201 Westlake Drive, Austin, Tx 78746 or call (512) 327-1888

Resorts

LITTLE ST. SIMONS ISLAND

One of Georgia's "Golden Isles"

Birding, beachcombing, riding, wildlife photography, fishing or just relaxing on a secluded 12,000 acre island with miles of unspoiled ocean beaches, forests and marshes. Over 200 species of birds. Maximum of 10-15 guests at a time. Excellent food and accommodations. Professional naturalists on the staff. P.O. Box 1078N, St. Simons Island, GA 31522 Phone (912) 638-7472

NEW MEXICO. Guided tours—wildflowers, birds, prehistoric dwellings. Bear Mountain Ranch, Silver City, NM 88062 (505) 538-2538

Tours/Trips

AFRICA IS Affordable! 33 Fascinating Nature/Culture Programs. Forum Travel, 2437 Durant, Berkley, California 94704 (415) 843-8294

ALASKAN WATER ADVENTURES. Kayaking, Rafting, Birding in Prince William Sound and Copper River Basin. College credit available. Open Door. Box 1185N, Cordova, Alaska 99574 (907) 424-7466

BICYCLING TOURS IN FRANCE, Sept. & Oct. '82. Two unusual private two-week cycling tours, Chateaux of the Loire & Brittany in Sept.; Dordogne Valley in Oct. For only 10 to 15 adults who enjoy exercise plus hotel amenities & fine food. Details write: Nan Rheault, R.F.D. Vineyard Haven, MA 02568

DISCOVER BAJA! Join experienced naturalists and crew for leisurely ocean-going explorations of the wilderness islands and lagoons of Baja's Pacific coast, the Sea of Cortez, or Mexico's tropical west coast. Enjoy whales, seals, dolphin, birding, fishing, nature study, island hiking, and more! Excellent photo opportunities. Small groups,relaxed pace. Trips 4-10 days year-round for individuals or groups. Color brochure: Pacific Adventures Charter Service, 2445 Morena Blvd., Suite 200H, San Diego, CA 92110 (714) 275-4253

EXPLORE THE SEA OF CORTEZ with Scripps Aquarium Oct. 17-23, 1982. Dive and collect Mexican marine life for exhibits and research. Scuba certificates required for divers. Scripps Aquarium-Museum A-007, La Jolla, CA 92093

GALAPAGOS HIKING AND SAILING EXPEDITIONS. Small groups. 1982 dates: July 7, August 4. Charters. Machu Picchu options and Chili ski options. Inca Floats, 5982N Balboa, Oakland, CA 94611 (415) 339-9095

GALAPAGOS ISLANDS. Economic tours from $1638. Including airfare. 4, 5, 8, & 15 days Galapagos, all meals. Options, mainland Ecuador, Amazon, Cuzco/Machu Picchu. University credit available. Joseph Colley, Last, Inc., 43 Millstone Rd., Randallstown, MD 21133. (301) 922-3116

INDIA/NEPAL WILDLIFE SAFARI: Outstanding game observation in three major reserves + Delhi, Taj, Kathmandu, Himalayas. $1375.00. Also, comprehensive program of trekking expeditions in Nepal's Everest & Annapurna regions from $895.00. Airfares additional. Free brochure. Himalayan Travel, Inc., Box 481-NH, Greenwich, CT 06830. Toll Free (800) 243-5330.

KENYA—Very exclusive photographic safaris for up to six, choosing your own itinerary, at Packaged Tour prices with Mervyn Carnelley, Box 79, Naivasha, Kenya

NEW ZEALAND WALKABOUT: Escorted nature and hiking tours featuring New Zealand's scenic National Parks, plus the Milford Track. Pacific Exploration Co., Box 3042-N, Santa Barbara, California 93105 (805) 687-7282

SERENGETI-NGORONGORO: natural history, photographic and hiking safaris in wildlife areas. Dr. D. Stevens, Skerry Rd., Leverett, MA 01054 Tel. (413) 367-2208.

UNCOMMON LATIN AMERICA: Affordable Travel to Fascinating Nature/Legendary Cultures. Groups or Individuals. Forum Travel, 2437 Durant, Berkeley, California 94704 (415) 843-8294

RATES AND STYLE INFORMATION

$1.75 per word; 16 word ($28) minimum. *Display classified* is $150 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY to: The Market, NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024. Please include your personal address and telephone number, issue preferred, and suggested heading.

ASIAN TREASURES

Asia: Traditions and Treasures by Walter A. Fairservis Jr, with color photographs by Lee Boltin. 86 color plates of peerless Asian treasures; 114 sepia plates of early, rare, and unique photographs from the collections of the American Museum of Natural History.

The American Museum of Natural History created a special, limited edition of 500 autographed copies of **Asia: Traditions and Treasures** to commemorate the opening of the magnificent Hall of Asian Peoples, the largest collection of Asian ethnology and art in the West. Some of these rare volumes were presented to generous contributors to the hall, and the rest were offered for sale to a select group of Museum donors and friends. This is the first public offering of this limited edition.

Only forty-five numbered volumes of this collector's edition remain. Each volume of this strictly limited edition is bound in a covering of pure silk, slipcased, and stamped in 22 karat gold. Each book is individually signed by Dr. Fairservis (who spent 14 years creating the Hall of Asian Peoples) and Mr. Boltin (the well-known photographer who also took all the King Tut photographs). Volumes are $135 each, plus $5 shipping and handling.

To order, please call Robert De Angelis at the American Museum of Natural History, (212) 873-1498.

This offer is open *only* to Members of the American Museum of Natural History.

NATURALIST'S COLOR GUIDE

"This is the book on the subject of color in the natural world that will be the standard now for decades to come...you will wonder how you did without it."
—Roger Caras, *CBS Pets and Wildlife*

"A color standard vital for ornithologists."
—Books about Birds

"We now have a coding system whereby we can all talk more or less the same language in describing a bird's color." ***—Bird Banding***

This is what the critics are saying about the *Naturalist's Color Guide* by Frank B. Smithe, published by the American Museum of Natural History.

182 colors most often encountered by naturalists and wildlife artists. Each color is deposited in a swatch of non-fading lacquer on heavy cards in a looseleaf field binder. Each color is exact, and was measured spectrophotometrically both before and after deposition.

Includes a book about the colors chosen for the guide and where they may be found in nature. An essential field guide for ornithologists, artists, entomologists, and botanists.

To order, please fill in the coupon. Members of the Museum may take a 10% discount.

I would like to order______copies of the *Naturalist's Color Guide* at $17.50 each. (Please add $2.50 shipping and handling charge with each order.) Total enclosed: $________

Name

Address

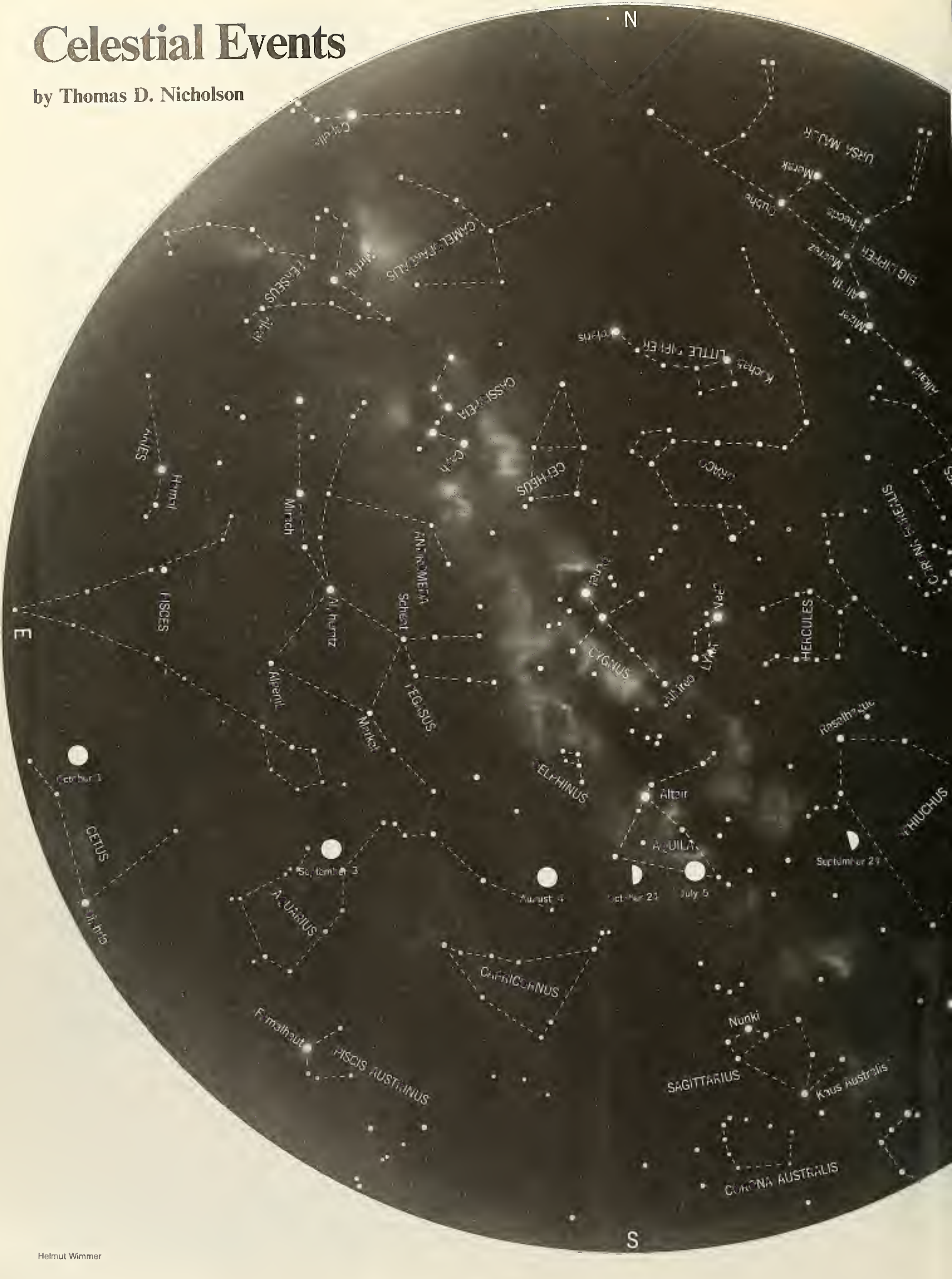
City State Zip

(Please enclose check with order, and make check payable to the American Museum of Natural History.)

Mail coupon to: Natural History—Publications, 77 West 77th Street, New York, NY 10024. Please allow 6 to 8 weeks for delivery.

Celestial Events

by Thomas D. Nicholson


N
S
E
Capella
URSA MAJOR
Merak
Dubhe
Phecda
BIG DIPPER
Megrez
Alioth
Mizar
Alkaid
CAMELOPARDALIS
PERSEUS
Mirfak
Algol
Polaris
LITTLE DIPPER
Kochab
CASSIOPEIA
Caph
CEPHEUS
DRACO
ARIES
Hamal
Mirach
ANDROMEDA
PISCES
Alpheratz
Scheat
Deneb
CYGNUS
Vega
LYRA
Albireo
HERCULES
CORONA BOREALIS
Algenib
PEGASUS
Markab
Rasalhague
October 1
CETUS
DELPHINUS
Altair
AQUILA
OPHIUCHUS
September 3
August 4
October 21
July 5
September 21
AQUARIUS
Diphda
CAPRICORNUS
Fomalhaut
PISCIS AUSTRINUS
Nunki
SAGITTARIUS
Kaus Australis
CORONA AUSTRALIS

Helmut Wimmer

Arcturus
W
July 27
SCORPIUS

All Month Three planets in the evening sky, Mars, Saturn, and Jupiter, continue to move slowly eastward through Virgo, near the bright star Spica. You can find the four objects easily any evening by looking first for Jupiter, high in the south at dusk, farther to the west and lower later in the evening. Early in July, Spica will be the next object to Jupiter's right, then Saturn, and lastly Mars. But Mars is moving to the left so rapidly that it switches position with Saturn on the 9th and with Spica on the 21st. At the end of the month, therefore, the planets will be lined up in this order: Jupiter, Mars, Spica, and Saturn, from left to right, and all four will be more closely gathered together than at the beginning of July. In the morning, Venus is getting dimmer (although it is still very bright), and its distance from the sun is decreasing. However, the planet is becoming more prominent as a morning star because the tilt of its orbit to the horizon is becoming more favorable. Mercury is also a morning star until the 25th.

July 1: The waxing gibbous moon is ten days old tonight, in the constellation Libra. It remains in the evening sky until the 6th, then rises after sunset.

July 2: The reddish star below the moon tonight is Antares, in Scorpius.

July 3–4: The star near Venus on these two mornings is Aldebaran, in Taurus.

July 4: The earth is at aphelion (farthest from the sun) and the moon is at apogee (farthest from the earth) today.

July 5–6: A total lunar eclipse occurs tonight, the fourth eclipse of the seven that take place in 1982 and the first to be generally visible throughout North America. Events and times are as follows (be sure to adjust for daylight time and for other time zones): eclipse begins at 12:33 A.M., EST; total eclipse begins at 1:38 A.M., EST.

July 9: Mars has been racing eastward (to the left) through the stars of Virgo since it ended its retrograde motion in mid-May. It catches and passes Saturn today, moving past the more distant planet from right to left. Saturn is also moving easterly, but much more slowly. Mars, more than five times brighter than Saturn last April, is now very much dimmer, not much brighter than Spica and Saturn.

July 13: Last-quarter moon, moving into Aries.

July 16: The waning crescent moon is moving through Taurus. In the morning, the Pleiades star cluster (the "Seven Sisters") is above the moon.

July 18–19: The crescent moon passes Venus close enough on the 18th to cover the planet (an occultation) over part of the South Pacific region. The waning moon is to the right and above Venus in the morning sky of the 18th, to the left and below on the 19th.

July 19–21: The moon is at perigee, nearest the earth, on the 19th, and new moon occurs on the 20th, less than 22 hours later. Perigee spring tides (substantially stronger than normal ones) will be felt on the night of the 20th and on the 21st.

July 21: Mars has been moving through Virgo between Saturn and the bright star Spica. It passes Spica today and moves to the left (east) of the star.

July 22: If you can see the young crescent moon early this evening, the star near it is Regulus, in Leo.

July 25: Mercury is in superior conjunction, in line with the earth and sun but beyond the sun. It moves to the sun's left to become an evening star.

July 26: The waxing crescent moon passes Saturn, Spica, and Mars today, in that order from right to left. On the evening of the 25th, the moon is to the right of the trio, nearest to Saturn; on the 26th it is to the left, nearest to Mars. The very bright object still farther east (left) is Jupiter.

July 27: Today's first-quarter moon passes Jupiter and appears to its left (east).

July 28–29: The Delta Aquarid meteor shower reaches maximum tonight. After midnight, you might expect to see up to 20 meteors per hour.

July 31: The star below and to the right of the gibbous moon this evening is Antares, in Scorpius.

The summer Sky Map shows the sky for the months of July, August, and September from latitude 40° N at the evening hours given below. To use the map, hold it vertically in front of you with the north (N) at the bottom, and match the lower half of the map with the stars you see when you face north. As you face in other directions, roll the map to bring the corresponding compass direction to the bottom of the map.

The stars move west continuously during the night. By morning (before dawn) stars on the western half of the map will have set, those on the eastern half will have moved into the west, and new stars (those of the spring evenings) will have risen in the east. The map represents the sky at about 2:00 A.M. on July 1; 1:00 A.M. on July 15; midnight on July 31; 11:00 P.M. on August 15; 10:00 P.M. on August 31; 9:00 P.M. on September 15; and 8:00 P.M. on September 30. Add one hour for daylight time. The map can be used for an hour or more before and after the times given.

Additional Reading

Elephant Seals (p. 40)

"Being on the coast of California in 1852, when the 'gold fever' raged, the force of circumstances compelled me to take command of a brig, bound on a sealing, sea-elephant, and whaling voyage" wrote C.M. Scammon, a whaling captain and amateur naturalist, in his only book, *The Marine Mammals of the Northwestern Coast of North America*, published in 1874. Scammon's book, divided into three parts—Cetacea, Pinnipedia, and the American Whale-Fishery—is of interest as a historical account of a period when hunting was unlimited and marine mammals were abundant more than for its zoological value. His chapter on the elephant seal is on pages 115–23 of a reprint, with an introduction by V.B. Scheffer, that was published by Dover Books, New York, in 1968. *Diving Companions*, by J.Y. Cousteau and P. Diolé (Garden City: Doubleday and Co., 1974), is an account of a *Calypso* tour throughout different parts of the world to study sea lions, elephant seals, and walruses. To observe the elephant seal, Cousteau and his crew sailed to Guadalupe Island, off Baja California, where the seals gather during the hunting season (pp. 91–137). In "Social Status and Mating Activity in Elephant Seals," B.J. Le Boeuf and R.S. Peterson (*Science*, vol. 163, pp. 91–93) state that elephant seals at Año Nuevo Island have a social hierarchy similar to the pecking order of domestic chickens. The seals achieve status by fighting and maintain it by threat displays; higher status leads to more copulations with females. K.S. Norris edited *Whales, Porpoises, and Dolphins* (Berkeley: University of California Press, 1966), a compilation of articles from the proceedings of an international symposium on cetacean research held in the early sixties. *Marine Mammals*, a readable compendium of articles on the adaptations, biology, and behavior of marine mammals of eastern north Pacific and arctic waters, edited by D. Haley (Washington, D.C.: Pacific Search Press, 1978), contains "Northern Elephant Seal," by R.L. DeLong (pp. 206–11). V.B. Scheffer's *Seals, Sea Lions, and Walruses* (Stanford: Stanford University Press, 1958) is a systematic review with information on the taxonomic history, evolution, geographical range, and population of the forty-seven kinds of pinnipeds. *Mammals of the Ocean*, by R.M. Martin (New York: G.P. Putnam's Sons,

This winter you can discover the fabulous natural wonders and human achievements of Southeast Asia with the American Museum of Natural History.

INDIAN OCEAN ADVENTURE
January 21 to February 9, 1983
India, Sri Lanka, Burma, Thailand and Singapore

INDONESIAN ODYSSEY
February 3 to 24, 1983
Bali, Java, Komodo, Sulawesi and Singapore

American Museum of Natural History
Discovery Tours
Tel. (212) 873-1440
Central Park West at 79th St. New York, NY 10024

Please send an itinerary for the ☐ Indian Ocean Adventure
☐ Indonesian Odyssey.

Name (please print)

Address

City State Zip

Flight from U.S.A.
Bombay
India
Arabian Sea
Madras
Kanchipuram
Mahabalipuram
Bay
Cochin
Trincomalee
Kandy
Colombo
India

Travel with numerous Museum lecturers to discover the paradise islands and cultures of Southeast Asia. (Your traveling faculty will include a geologist, naturalist, astronomer, anthropologist and ecologist.) Discover extraordinary Hindu-Buddhist temples, exotic cultural performances, exquisite traditional crafts and artworks, and warm friendly peoples.

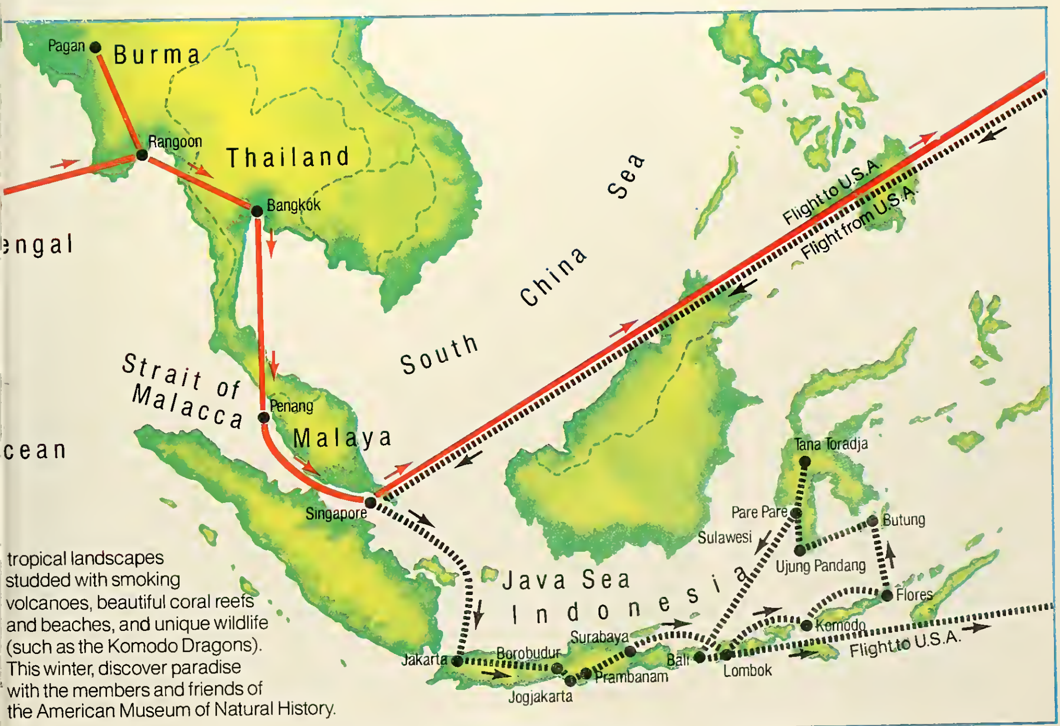
Relax on the Museum's exclusively chartered luxury vessel, the *Illiria*, as she cruises through

1977), is a survey of the marine mammals; also valuable is R.T. Orr's *Marine Mammals of California* (Berkeley: University of California Press, 1972).

Great Temple (p. 48)

The December 1980 *National Geographic* contains three useful articles on the Aztecs: "The Aztecs," by B. McDowell, with photographs by D. Hiser and paintings by F. Dávalos (pp. 704–51); "The Building of Tenochtitlan," by A.F. Molina Montes, with paintings by F. Dávalos (pp. 752–65); and "New Finds in the Great Temple," by E. Matos Moctezuma, the general coordinator of the Great Temple project, with photographs by D. Hiser (pp. 766–75). Matos recounts the discovery of the temple and discusses the significance and historical background of some of the finds. Last year, the National Geographic Society published G. Stuart's *The Mighty Aztecs*, which traces the rise and fall of the complex Aztec empire; to order a copy, send $6.95 to the society's Special Publications Division, Washington, D.C. 20036. *The Art in the Great Temple* features photographs by Fernando Robles, text by Mexican poet Rubén Bonifaz Nuño, and a preface by Gastón Garcíia Cantú, director of the National Institute of Anthropology and History, Mexico City (Córdoba, México: Instituto Nacional de Antropología e Historia, 1982). This large-format book, which is most notable for its detailed color photographs of many of the temple's relics, sells for $65 (cloth) and is distributed by William Kaufmann, Inc., of Los Altos, California. For a good introduction to Aztec history, readers can turn to N. Davis's *The Aztecs* (Norman: University of Oklahoma Press, 1980). *The Aztecs of Central Mexico*, by F.F. Berdan (New York: Holt, Rinehart and Winston, 1982), is largely devoted to an ethnographic reconstruction of Aztec culture as it flourished in the period immediately preceding the Spanish conquest; it covers the origin of the Aztecs, their economic organization, social structure, daily life, imperial politics and warfare, religion, intellectual and artistic achievements, and consequences of the conquest. For a description of the Spanish takeover as seen by the head of the conquistadors, see *Hernân Cortês: Letters from Mexico*, translated and edited by A.R. Pagden (New York: Orion Press, 1971).

Rita Campon


Pagan
Burma
Rangoon
Thailand
Bangkok
engal
Sea
China
South
Flight to U.S.A.
Flight from U.S.A.
Strait of Malacca
Penang
Malaya
cean
Singapore
Tana Toradja
Pare Pare
Sulawesi
Butung
Ujung Pandang
Java Sea
Indonesia
Flores
Komodo
Surabaya
Jakarta
Borobudur
Bali
Lombok
Flight to U.S.A.
Prambanam
Jogjakarta

tropical landscapes studded with smoking volcanoes, beautiful coral reefs and beaches, and unique wildlife (such as the Komodo Dragons). This winter, discover paradise with the members and friends of the American Museum of Natural History.

"A wonderful book, full of travel and people. Superb anthropology."
—PAUL THEROUX

"A moving portrayal... His book is a blunt, controlled plea for recognition of the Indian's hybrid culture."
—San Francisco Chronicle

Illustrated with maps and tables. $16.50

Maps & Dreams
by Hugh Brody

How Curtis's famous Indian photographs distorted the past

"Few books published during this decade will convey the power, shock, disappointment or sense of betrayal as does this extraordinary work"
—San Francisco Chronicle

Illustrated with 130 photographs. Size 11" x 8½". Paperbound $14.95.
Quality Paperback Book Club Alternate.

THE VANISHING RACE AND OTHER ILLUSIONS
Photographs of Indians by
Edward S. Curtis
by CHRISTOPHER M. LYMAN
Introduction by Vine Deloria, Jr.

Now at your bookstore
Pantheon

An Encyclopedic Tour de Force

by Caryl P. Haskins

The Growth of Biological Thought, by Ernst Mayr. *The Belknap Press of Harvard University Press. $30.00; 974 pp.*

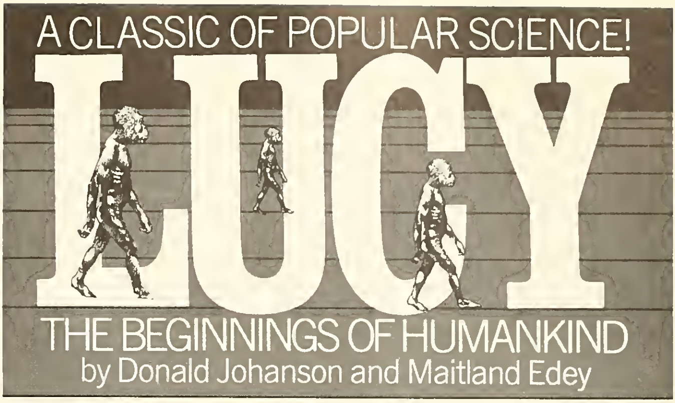
This year marks the hundredth anniversary of the death of Charles Darwin, and it could hardly be more fittingly marked than by the appearance of Ernst Mayr's *The Growth of Biological Thought.* This book may well prove the crowning work of a biologist who for the past fifty years has continually been at the center of research and concept building in the field of evolution. In the first half of this century, thinking about evolution stood at the point of a major conceptual burst, reflecting the growing interaction of highly significant new findings about inheritance and genetic influences in evolution with older Darwinian notions—the "neo-Darwinian revolution." It was Mayr's path-breaking book *Systematics and the Origin of Species,* published in 1942, that provided one of the important thresholds for the new thinking.

For several years Mayr has been deeply interested in the contiguous areas of the history of biological thought, the philosophic background of the life sciences, and the analysis of evolutionary phenomena in the widest theater. The present work—a reflection of that spectrum of concerns—encompasses an extraordinary sweep of scholarship, ranging from extremely broad syntheses and penetrating analyses to a well-nigh incredible wealth of historical and scientific detail. In this combination, it is probably unique in contemporary biological literature.

The volume opens with an interesting and unexpected essay on how to write a history of biology, which scientific historians in particular will surely read with much attention. There follows a wide-ranging and penetrating social-historical-scientific discussion of the place of biology in the sciences. Mayr has long emphasized the historical contrasts in the mode of thinking of the pioneers in the mathematical and physical sciences—including Newton and his followers—and the early biological and medical scientists, differences that are probably inherent in the contrasting nature of those fields. Here he stresses anew the antagonisms of these thought modes, reaching at least as far back as ancient Greece, and discusses how the power and approaches underlying the Newtonian revolution in physics may actually have retarded developments in the immature biological sciences over a long period.

These reflections are followed by an equally significant essay on the changing intellectual milieu of biology—and especially of evolutionary biology—where Mayr himself has wielded such a key influence. The emergence and rapid growth of the sciences of ethology and ecology, and their interactions with evolutionary thought, are particularly emphasized, as is the commanding role of modern molecular biology, with its characterization of DNA and the elucidation of its genetic role. Note is taken, also, of the influence on biological research at both experimental and theoretical levels of major modern developments in instrumentation, such as the electron microscope. This section includes a bold attempt to define periods in the history of the development of biological thought and a challenging discussion of the difficulties and anomalies inevitably encountered at both theoretical and operational levels in such an effort. It ends with a discussion of the current stage of biology, from the standpoints of contemporary philosophy and of science.

The overwhelming diversity of the organic world, its characterization, and the probing of its ultimate causes have been lifelong preoccupations of Mayr. His own career began as an ornithologist with special interests in the classification and the meaning of species among birds—an interest already broadened and deepened far beyond this special group by the time of his 1942 volume. So, "The Diversity of Life," the next section of this latest book, is of particular interest. The historical time frame of human concerns with systematics begins with prehistoric perceptions of diversity and progresses through the Greco-Roman era and on into the periods of the great European explorations of newly appreciated parts of the globe—the voyages of Humboldt and Bonpland, of Darwin and Wallace. Their work is of course widely known today, though by no means always accurately appreciated. But of particular interest are the accounts in this section of a host of other naturalist-explorers of the time, whose names are but little noted today. Recalling them conveys some inkling of how powerful the European—and American—impetus was to learn of natural life in remote regions during the nineteenth century. The account also emphasizes how much sophistication of taste and of concept increased over that span, contrasting the avid and largely uncritical appetite for the spectacular at the century's beginning with the far more


A CLASSIC OF POPULAR SCIENCE!
LUCY
THE BEGINNINGS OF HUMANKIND
by Donald Johanson and Maitland Edey

LUCY...a tiny lady three feet tall, sixty pounds light, and 3.5 million years old—the oldest, most complete skeleton of any erect-walking human ancestor ever found.

LUCY...the story of her dramatic discovery is "one of the most compelling scientific investigations ever undertaken" (*The New York Times Book Review*).

LUCY...the controversial bestseller that recounts this story is "a masterpiece of popular science" (Robert Jastrow) that "does for the study of ancient man what Carl Sagan has done for the cosmos" (*The Plain Dealer* [Cleveland]).

A Main Selection of
The Book-of-the-Month Club
$9.95 424 pages 5¼" x 8"

Now in Quality Paperback from WARNER BOOKS

To order send $9 95 plus $1 00 to cover postage and handling to Dept PAA (NH) 37-036-3 Warner Books 75 Rockefeller Plaza New York NY 10019
Check or money order only Allow 4 to 6 weeks for delivery

Enjoy the romance...

Send for a luxurious color catalogue of beautiful lingerie. French bra and bikini sets, lacy teddies, gowns, kimonos & much more.

Victoria's Secret designer lingerie

Send $3 to Victoria's Secret, Dept. NH-07
Box 31442, San Francisco, CA 94131
Boutiques: San Francisco, Palo Alto & Cupertino

for Zoom & Telephoto Lenses
SLR CAMERA CASE
Solid Protection
PATENTED

Special Safari Package

$44.95 Includes New Expedition Harness. Visa Mastercharge

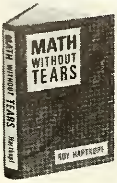
$6.00 Rugged 2" Black Belt (fits to 43" waist)
$5.00 Wide Shoulder Strap (holds 3 rolls film)
$1.50 Postage $4.00 Air Rush
Immediate Shipment

- The ultimate combination of a lightweight hardshell with thick foam padding provides solid protection against shock, rain, snow and dust.
- Quick, easy access to equipment.
- Easily hung from a pack, belt or shoulder strap.
- Modular units unscrew to vary the case length.
- Accommodates most SLR's with almost any lens (up to 3¼" dia.) attached to the camera (will not accommodate some photomic metering or any detachable auto winders).

For more information, or to place order
CALL TOLL FREE
1-800-231-1753
Texas: 713-465-2232

safari
Satisfaction Guaranteed
Safari Camera Case, Inc.
P.O. Box 19972 H
Houston, TX 77224
713-465-2232

BOOK HUNTING?
Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: BOOKS-ON-FILE
Box 195 Dept. 72
UNION CITY, NEW JERSEY 07087



MATH WITHOUT TEARS
Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written.
Learn math in the comfort of your own home at minimum cost.
Order Now $11.95 plus $1.25 hdlg
EMERSON BOOKS, INC.
Dept. S50-G, Verplanck, NY
10596
10 Day Money Back Guarantee

Joseph L. Sax
Mountains Without Handrails
Reflections on the National Parks
Sax proposes a novel scheme for the protection and management of America's national parks, giving perspective to the longstanding and bitter battles over use of our national parklands. $10.00/*paper* $5.95
The University of Michigan Press
Dept. B P.O. Box 1104
Ann Arbor, MI 48106

Don't go without a single copy of NATURAL HISTORY
Now you can order back issues from 1970 to present.
Natural History, Central Park West at 79th St., N.Y., N.Y. 10024 Attn: Circulation Dept.
Date(s) of issue(s)________
Amt. enclosed ($2.50 per issue)________
Name________
Address________
City________State____Zip____
Please allow 6 weeks for processing

critical attitudes at its end. And to all this wealth of knowledge of life forms accessible to the naked eye was now added the immense diversity of newly visible microscopic life that the developing magnifiers opened, heralded by the instruments of van Leeuwenhoek. This is to say nothing of the contributions of developing paleontology and the new sophistication and scope in the interpretations of fossil evidence that were hallmarks of the time. All this is prelude to discussions of the nature, the mission, and the scope of systematics.

Following sections—on macrotaxonomy, grouping according to common ancestry, and microtaxonomy, the science of species—were for this reviewer some of the most interesting in the volume, reflecting the thoroughness and the profundity of their exposition. No attempt at condensation can do them remote justice. They must be read in full. And the same may be said of the part dealing with evolution.

Here again the exposition of modern evolutionary theory is preceded by a significant historical discussion, beginning with remote conceptual origins and leading on to the diverse and divergent concepts that bloomed just before the age of Darwin. The heritage of the pre-Lamarckian period, the work of Lamarck and his followers, and the "bridging" period between Lamarck and Darwin are admirably summarized. An especially stimulating discussion deals with the delaying effect that the widespread popularity of Lamarckian ideas had on the general acceptance of Darwinian evolutionary models—a delay of some 75 years. The history of the widespread resistance to Darwinian ideas, and its gradual breakdown, with the fundamental changes in philosophy that it entailed, are presented in illuminating detail in the context of both English and Continental thought. The role of uniformitarian thinking in this struggle toward Darwinism is described in special perspective. Mayr dramatically recounts the role played by the appearance of Robert Chambers's amazingly popular *Vestiges of the Natural History of Creation*—its author none other than the creator of the famous Chambers' Encyclopedia. Such accounts bring home forcefully how widely spread were the "precursor" ideas about evolution, and how many thinkers had touched the fringes of the subject, well before Darwin. That the final "watershed" had to wait for the appearance of the *Origin of Species* constitutes a fascinating chapter of social, as much as of scientific, history, as Mayr emphasizes, and illuminates what a revolution Darwin himself had to accomplish in the years after the voyage of the *Beagle*.

The author's account of Darwin himself, and his analysis of the abilities, the circumstances, and the thinking that culminated in the *Origin* and its quantum influence on biological thought is the most detailed, keenly analytical, and above all, the most truly appreciative of the special quality of Darwin's genius known to this reviewer. It is particularly gratifying to find many myths about Darwin that have long been firmly established in the literature exploded by the relevant evidence. These include the timing of Darwin's own "conversion" to his ultimate notions of evolution, particularly with respect to the *Beagle* journey (they were *not* well formed at the conclusion of that voyage) or the timing of his extraordinary self-training as a naturalist (clearly he had become wonderfully grounded in natural history long before the *Beagle* left Plymouth).

There follows an excellent account of Alfred Russel Wallace's parallel discovery of the concept of speciation in the natural world, of selection, and of evolution, so astonishingly convergent with that of Darwin. Succeeding chapters dealing with Darwin's evidence for evolution and common descent and with natural selection as a causative element in evolution are far too extensive, detailed, and profound to be dealt with adequately here. Suffice it to say that they present a series of analyses that, in the richness of their background information and their clarity, rooted in a lifetime of reflection, are superb. They provide a "bridge," too, to historical considerations of the diversity and synthesis of contemporary evolutionary thought.

An extensive exposition of the facets of post-Darwinian synthesis follows—the emergence of modern current evolutionary concepts, again one of the most interesting parts of the book for this reviewer. The contemporary elision of evolutionary biology with all the other branches of the life sciences is discussed, with emphasis on the contributions of ecology, ethology, and molecular biology. There is an especially illuminating discussion of the role of mutations and chromosome rearrangements in the evolution of species—a field that karyological investigations of sibling species, particularly among the insects, has given special poignancy today.

Questions surrounding the mode of origin of life on the planet receive attention, in both historical and current contexts. Issues of both group and sexual selection are covered. Succeeding chapters deal with variation and its inheritance, and return to historical reviews of the growth of ideas about the physical nature and mechanisms of inheritance from ancient times to

NATURAL HISTORY MAGAZINE

SAVINGS CERTIFICATE

For *FOR THE SUM OF 9 DOLLARS*

This savings certificate saves you $9.00 off the single copy rate for 1 year on new subscriptions or renewals (12 beautiful and thought-provoking issues) of NATURAL HISTORY magazine, including membership in the American Museum of Natural History and all the benefits that go with it. As soon as we receive your order, we'll start your subscription and send your membership card.

☐ **YES,** Please send me a full year of Natural History at the low rate of $15 for 12 issues including Museum membership

☐ I want to save more. Send me 2 years of Natural History (24 issues) which includes membership for only $26 (a $22 savings off the single copy price).

☐ New ☐ Renewal

Name ____________________ (please print)
Address ____________________
City ____________________
State __________ Zip __________

☐ Payment enclosed ☐ Bill me later
Charge my ☐ Visa ☐ MasterCard
☐ American Express

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
Account number

Send gift to: J553

Name ____________________ (please print)
Address ____________________
City ____________________
State __________ Zip __________

Gift card to read ☐ 1 year $15 ☐ 2 years $26

Signature ____________________

Moneyback guarantee if not satisfied.

Please add $5 per year for postage outside the USA. Payment must be included.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

POSTAGE WILL BE PAID BY ADDRESSEE

NATURAL HISTORY
P.O. Box 4200
Bergenfield, N.J. 07621

the forerunners of Mendel, to the Mendelian era, and on to the present. The closing chapters are devoted to reviews of theories of the gene and discussions of the chemical basis of inheritance. And an epilogue, in which questions of the philosophy and etiology of science and a discussion of a "science of science" once again take center stage, completes the book.

It is inevitable that some readers with special interests will find points to carp about or at least to wish more thoroughly elaborated. The present reviewer is no exception. One might wish, for instance, that the exposition of theories and speculations about the dynamics of the evolution of biological societies had been allowed somewhat more space for deeper presentation, considering their special contemporary interest. Issues such as the putative roles of genetically based altruistic behavior, kin selection, and inclusive fitness in social evolution are mentioned, to be sure, and brief note is taken of Hamilton's germinal 1964 contribution in this area, and to the contributions of a number of more recent workers. But nowhere is there discussion—or mention—of Axelrod's and Hamilton's newest and notable contribution, in which computer analyses are derived, suggesting routes of social evolution that may involve parameters quite other than those considered in the now-conventional wisdom. But minor omissions of this sort, truly inevitable in a work of this scope, are but drops in an ocean of information and learning.

It may be safe to say that so comprehensive a synthesis—and at the same time so detailed a discussion—of every arena of evolutionary biology, in a historical framework ranging from ancient beginnings to its present conditions, has not been undertaken before. Surely it has never been undertaken by so widely and deeply learned an authority or with such painstaking and thorough exposition of the most detailed, as well as of the broadest, historical and contemporary aspects of the field. It is literally an encyclopedic tour de force. If Darwin were to return on this the hundredth anniversary of his death and read the book, he surely would be both pleased and awestruck. And for the rest of us, scientists and naturalist-laymen alike, this must stand as an invaluable lexicon for many years to come.

Caryl P. Haskins is a biologist with longstanding interests in the processes of evolution, in particular the genesis, evolution, and dynamics of animal societies. He is the author of five books, two dealing with aspects of insect social evolution, and numerous papers.

The Questers Program for Fall & Winter 1982

Stimulate your mind on a Questers nature tour. We search out the plants and animals, birds and flowers. and explore rain forests, mountains and tundra, seashores, lakes and swamps. There is ample time to photograph, absorb, reflect. Naturalist guides, small tour parties, first-class accommodations.

Worldwide Nature Tours
Fall & Winter 1982 Departures

The Americas
Everglades: 11 days, Nov. 4, Apr. 7 • Hawaii: 15 days, Oct. 10, Dec. 19, Feb. 10, Mar. 24 • Southern Mexico: 14 days, Dec. 19, Feb. 13 • Panama & Costa Rica: 14 days, Dec. 18, Feb. 12 • The Amazon: 17 days, Oct. 10, Nov 14, Jan 9 • Ecuador and Galapagos: 15 days, Oct. 28, Dec. 30, Feb. 10 • Peru: 17 days, Nov 6 • Patagonia & Tierra del Fuego: 21 days, Nov 6, Jan. 10 • Trinidad & Tobago: 11 days, Nov 8, Mar. 7

Asia & Africa
The Himalayas: 23 days, Oct. 7, Mar. 17 • India: 23 days, Oct. 30, Jan. 29 • Sri Lanka: 18 days, Nov 19, Feb. 18 • Kenya: 23 days, Oct 21, Feb. 3.

Australasia
Australia & New Zealand: 30 days, Oct. 2, Feb. 12 • New Zealand & Milford Track: 22 days, Nov 12, Feb. 11.

New & Special Tours
We will also be offering in 1983 a number of new and special tours. Among them are:
- New Guinea
- Walking in the Foothills of the Western Himalayas
- Japan
- Madagascar/Réunion/Mauritius
- Okefenokee Swamp & Georgia's South Coast

Write or call today for your complimentary Directory of Worldwide Nature Tours and to be placed on our mailing list. If you are interested in a particular tour, please request its Detailed Itinerary.

QUESTERS
Questers Tours & Travel, Inc.
Dept. NH, 257 Park Avenue South
New York, NY 10010 • (212) 673-3120

DISCOVERY TOUR TO THE NILE

American Museum of Natural History
Discovery Tours

Discover the world of ancient and modern Egypt on an American Museum 600 mile Nile Cruise. Explore with three lecturers the rich natural and archeological sites of an area which has fascinated visitors for centuries... A carefully planned itinerary (with a special two-day program in London visiting the British Museum with its curator) provides a relaxing and thorough three-week Discovery Tour. All of the major Nile archeological sites as well as the important wildlife regions are discussed and visited with your balanced team of eminent lecturers. Share with Museum staff and friends an unforgettable cruise. February 6-26, 1983. For further information and itineraries write to the **American Museum of Natural History, Discovery Tours,** Central Park West at 79 St., NY NY 10024, or call (212) 873-1440.

Father Knickerbocker the First

by Sidney Horenstein

On the west shore of the Hudson River, beneath the cliffs of the Palisades, is a colorful outcrop of 200-million-year-old sedimentary strata of Late Triassic age. In 1910, an important paleontological discovery was made in this outcrop of layered rocks. While inspecting the strata on a field trip in early March, three graduate students in geology from Columbia University spotted some unusual white bumps in the wave-washed rock. On careful examination, they decided that the bumps were bones. They took a few chips back to school where they studied them under the microscope and performed a chemical test to determine whether phosphorus, an important indicator of bone, was present. The students brought their conclusion that the chips were indeed fossil bone to the attention of their professor, who advised them to contact the American Museum of Natural History.

Assistant curators Barnum Brown and W. D. Matthews of the Museum traveled to the site, and after an "exhaustive investigation," they reached the conclusion that entombed in the rock was the complete skeleton of a "prehistoric monster of the dinosaur class." They estimated that the skeleton could be thirty to forty feet long and fifteen to eighteen feet high.

Several problems had to be overcome to secure this important specimen for the Museum. Because the rock was awash at high tide, the skeleton could not be chipped out of the rock at the site itself. It would have to be taken to the Museum embedded in its rocky tomb and left to dry out before the bones could be uncovered. Work on removing the specimen could only proceed at low tide. The most critical problem, however, was that the specimen was located on private property, just south of the boundary of the newly formed Palisades Interstate Park.

Museum officials undertook delicate negotiations with the owners of the land and after months of delay, persuaded them to part with the slab of rock for $100, which wasn't cheap for the time. Once permission was granted, Museum staff began to remove a block of sandstone encasing the fossil. First, however, they had to cut away about twenty to twenty-five feet of sandstone above part of the outcrop containing the bones. Once this was accomplished, the excavators determined that the slab of rock with its embedded fossils would only be about eight by five feet, a little more than one foot thick, and weigh more than 5,000 pounds. To get it to a road where it could be picked up, the slab would have to be hauled up the steep slope of the Palisades. After several attempts, this proved to be impossible, so a decision was made to saw up the block in such a way as to prevent damaging the bones. Assistant curator Barnum Brown enlisted the help of several preparators

Chain of Life

Mzima Springs is a chain of pools, two miles long and about six feet deep, in Kenya's Tsavo National Park. The Membership Office of the American Museum is presenting a film, *Mzima: Portrait of a Spring*, about the animal life supported by, and centered around, the spring—including hippos, fishes, cormorants, otters, crocodiles, eagles, and snakes. The program, open only to members and their guests, takes place in the Auditorium at 6:00 P.M., and again at 7:30 P.M. on Tuesday, July 20. Members are admitted free; tickets for members' guests are $2. Please call the Membership Office for tickets.

A Geology Day-Visit to Albany

A drive between New York City and Albany encompasses one billion years of geologic history. Sidney Horenstein of the Museum's Department of Invertebrates will lead a group of people on a geology trip to Albany with stops en route, a visit to the Albany State Museum, and a building-stone tour of the unusual Albany Mall. The fee is $55 ($50 for members) and the trip takes place on Saturday, July 17, from 9:00 A.M. to 6:00 P.M. Please contact the Education Department for more information.

The Great Temple

A major exhibition opens at the Museum on Tuesday, July 27, in Gallery 3. Entitled *Aztec Mexico: Discovery of Templo Mayor*, the exhibition looks at the recent, stunning excavation of the main Aztec temple buried under the streets of downtown Mexico City. Since the discovery in the late seventies, more than 6,000 ceremonial objects and offerings have been uncovered. For more information, see "Revelation of the Great Temple" on page 48 of this issue.

The Aztecs

In July the Education Department is offering an exciting series of four slide-illustrated lectures on the ancient Aztecs of Middle America. Taught by Esther Pasztory of Columbia University, the series, which precedes the opening in late July of *Aztec Mexico: Discovery of Templo Mayor*, will focus on four topics: Aztec History and Religion; Architecture and Sculpture of the Aztec Capital, Tenochtitlan; the Elite and Popular Arts; and the Discovery of Templo Mayor, the Great Temple. For those enrolled in the series there will be a private viewing of the new exhibition before the last lecture. Tickets for this series are $25 ($22.50 for members) and can be obtained from the Education Department.

Aztec Symposium

A symposium on Aztec culture will be held in the Auditorium on Wednesday, August 4, at 7:30 P.M. Presented in conjunction with the Templo Mayor exhibition, the symposium will be moderated by Gordon F. Ekholm of the Museum's Department of Anthropology. He will be joined by H.B. Nicholson, professor of anthropology at the University of California at Los Angeles; Emily Umberger, guest curator for the exhibition; and Eduardo Matos Moctezuma, director of the excavation. Matos Moctezuma will also lecture in Spanish on the history of the excavation on Thursday, August 5, at 7:30 P.M. in the Auditorium. Both the lecture and symposium are free and open to the public.

For more information about programs listed in this section, call the appropriate department: Education Department (212) 873-1300; Membership Department 873-1327; Hayden Planetarium 873-1300. Or write to the department at the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024.

from the Museum, and in a short time the specimen was in pieces and ready for transport by truck.

The fossil was carried across the Hudson on the Fort Lee ferryboat to the 129th Street landing, and from there taken to the Museum. The expenses for collecting and transporting the specimen amounted to $72.40. After the block dried the Museum had part of the matrix chiseled out, leaving the bones to stand out in relief on a background of rock. It planned to display the find in March of 1911 after a dramatic announcement and appropriate fanfare. Native fossils in New York City and its environs are quite rare, and to find a dinosaur was certainly an important event. Museum officials believed the discovery of the skeleton was "perhaps the most interesting and important of its character, from both the popular and scientific viewpoint, ever made east of the Mississippi River."

But much to the chagrin of the officers of the Museum, news of the find had leaked out during excavation of the specimen. In a few days the extinct reptile was raising more commotion than it had during the last several geologic periods. Not only was the fossil a rare find, but it was the oldest uncovered in the area up to that time. The newspapers gave the discovery a great deal of publicity. They questioned whether the creature was a Manhattanite or a resident of New Jersey and pressed the Museum scientists about whether it was a "commuter" from New Jersey to New York. The paleontologists explained that chances were that it did roam over Manhattan because the Hudson River did not exist at that time. As a result newspaper reporters concluded that the skeleton was the oldest resident of New York City and dubbed it Father Knickerbocker the First. One reporter wrote: "It was considered a good guess that this beast who went to New Jersey to die frolicked along what is now Broadway in the heyday of its youth, setting an example which has been followed down in much more recent times."

With the specimen safely at the Museum and the drying process completed, workmen began to chisel away the sandstone to uncover the bones. As more and more of the skeleton emerged, the scientists began to doubt the original identification of the specimen as a dinosaur. In addition, they found that only a portion of the skeleton was preserved. By coincidence, as the specimen was nearing its public debut, Frederich von Huene of Tübingen University, Germany, visited the Museum. Considered the foremost expert on Triassic reptiles, von Huene recognized the skeleton as a phytosaur—a large water-dwelling reptile but not a dinosaur at all. In 1913 his findings were published in the *Bulletin of the American Museum of Natural History*, where he reported that this specimen was a new species of phytosaur and named it *Rutiodon manhattanensis*.

Phytosaurs are a group of extinct twenty-foot-long reptiles that lived 200 million years ago and looked much like modern crocodiles. Scientists who first studied them thought they were plant eaters and named them phytosaur (from the Greek for plant lizard). We know today that this early interpretation was incorrect and that phytosaurs were carnivorous, preying on fish and other animals in streams and lakes. The phytosaurs lived in the Northern Hemisphere during the Late Triassic period and numerous specimens belonging to several genera have been found in North America, Europe, and India, which were then all joined in the supercontinent Pangaea. The phytosaurs belong to a completely different group of reptiles (thecodonts) than the crocodiles, even though they are similar in form. The crocodilians evolved just before the phytosaurs began to die out, and some scientists believe competition between the two groups caused the disappearance of the phytosaurs.

The Fort Lee phytosaur is on display in the Hall of Early Dinosaurs at the Museum, and looks like a chaotic jumble of bones embedded in a slab of sandstone. Next to it is a mounted skeleton of a phytosaur that was found in a coal mine in South Carolina, with a painting of how Father Knickerbocker the First may have looked in life.

Treasures From The Earth

Color Portfolio of Natural Specimens and Catalog of Minerals, Display Stands, Books and Natural Jewelry, $3.00

Dover Scientific

Box [illegible]

Mountain Shorts

You don't climb mountains?

Most of us don't! But we do spend a lot of time at the beach, boating, hiking, touring or just plain hammocking. Here's the most comfortable, most practical pair of shorts to come along in years, from Haband – the Surprising Savings Company in Paterson, N.J.

HUGE POCKETS! HUGE SAVINGS!

These are the real thing, with the full 12" deep front pockets tough reinforced double track stitching, big 8 x 7 inch cargo type buttoned flap back pockets, the works – Even the heavy, deluxe "Kilimanjaro Cloth" No-Iron polyester and cotton.

Great fitting, great feeling masculine shorts, in colors Desert Tan, Sky Blue, and Loden Green or Dark Indigo Blue. Even waist sizes 30 thru 54 IN STOCK!

HABAND 265 N. 9th St., Paterson, N.J. 07530

Mountain Shorts 2 pairs for 21.95
3 pairs for 32.50

HABAND – Executive Division
265 N 9 St., Paterson, NJ 07530
Please send me the shorts specified for which I enclose $.............. + $1.25 toward shipping.

Available in Sizes 30 thru 54
(Sizes 46 thru 54, add $1.25 ea. pair)

Or Charge To: ☐VISA ☐MasterCHARGE
Acct #________
Exp__/__/__

If on receipt I do not choose to wear them, I may return the shorts within 30 days for full refund of my remittance.

750-00D

Colors	Qty.	Size
TAN A		
Sky Blue B		
GREEN D		
Dark Blue F		

Name________
Street________ Apt. #____
City________
State________ Zip

HABAND for MEN

Fish, Fresh from the Farm

Catfish, hardy and disease resistant, adapt themselves well to aquaculture

by Raymond Sokolov

> So we went over to where the canoe was and while he built a fire in a grassy open place amongst the trees, I fetched meal and bacon and coffee and coffee-pot and frying-pan and sugar and tin cups, . . . I catched a good big catfish, too, and Jim cleaned him with his knife and fried him.
>
> When breakfast was ready we lolled on the grass and eat it smoking hot. Jim laid it in with all his might, for he was most about starved. Then when we had got pretty well stuffed, we laid off and lazied.
>
> *Huckleberry Finn*

With that one brief passage, Mark Twain catches the mood and myth of life on the Mississippi in the days of early settlement. Huck has made good his escape, has fled the entanglements of civilization just as easily as any river dweller could, hopping in a canoe and melting into nature. And, at the center of this master image of American pastoral, this perfect icon of folks freely roughing it, is the fish they find waiting bountifully for them in a meander of the great river.

A catfish completes the image of riparian ease. Unlike the wary deer that epitomizes the woodland life of the eastern states, the catfish swims right on over and hooks itself. Life in New England was hard and cold. Here by the river, a boy just floated downstream and sat down to catch his dinner.

There are still catfish in the Mississippi and other rivers that drain the American heartland. Left alone, they will cruise the bottom, scavenging with the help of sensory appendages that droop like whiskers from their mouths. These pendulous barbels are the reason the nation's most folkloric freshwater fish got its mammalomorphic name.

Catfish are remarkable in several ways. They get very large if nobody catches them first. A young man I met recently at a fish market in Greenville, Mississippi, told me about a ninety-pounder his father had landed. Catfish are our largest freshwater fish (sturgeon are anadromous, coming inland to spawn but spending much of their time at sea). Indeed, catfish are the world's largest freshwater fish. Probably the biggest of them all, *Silurus glanis* prowls the Danube and obtains a weight of several hundred pounds and a length on the order of ten feet at maximum. Its chief rival is *Pangasianodon gigas*, an almost equally immense denizen of the Mekong, worshiped and eaten with lavish festivity in Laos. Alan Davidson, the scholarly British ichthyogastronome, who ate this fish while serving as British ambassador in Vientiane before the revolution, tells me he has written a full monograph on this mysterious creature. No one knows for sure where they spawn or what their young look like. Perhaps Davidson has solved the problem. It is definitely the case that biological research has advanced our understanding of the lesser but still peerlessly

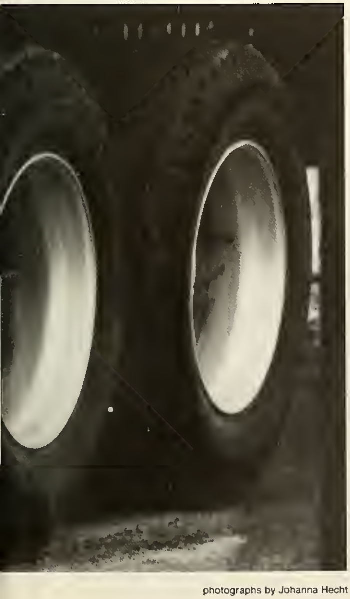
FARM FRESH
grain-fed
CATFISH
Hollandale MS.
Greensboro ALA.

A truck's rear mudguard advertises the area's catfish farm.

delicious American catfish of the genus *Ictalurus*.

I knew that something was afoot in the catfish world, but I wasn't more than vague about it when I started a three-day drive through Alabama and Mississippi not long ago. On country roads winding from Horseshoe Bend, Alabama, to Columbia, Mississippi, three regional foods dominated restaurant menus. Fried chicken, obviously. Barbecue, of course, cooking slowly over hickory in dozens of open pits. And, almost wherever you turned, catfish.

Rolled in cornmeal, crisply fried, and



photographs by Johanna Hecht

Pamper Yourself... with fine designer lingerie!
INTIMIQUE™
A Unique Collection of Luxurious Designer Lingerie!

Indulge yourself with our lacy, elegant camisoles, French pants, bra and panty sets, teddies, gowns and other luxurious lingerie from fine designers like Montenero, Stillman, Loré and others.

Send $2.00 to receive our exclusive Catalogue of Designer Lingerie. Mail to Intimique, Dept. 972 One Eastwood Drive, Cincinnati, Ohio 45227.

Share the Thrills of Exploring Outer Space!

$359.95 f.o.b. Hartford, Conn.

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

Criterion Manufacturing Co.
620 Oakwood Ave., W. Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION, MANUFACTURING CO., Dept. NH 116
620 Oakwood Avenue, W. Hartford, Conn. 06110
Please send your free Telescope Guide.

Name__________
Address__________
City__________ State__________

FADING FEAST

"*A fine and unusual book . . . A beautifully produced volume.*"—Cuisine

"*An entertaining and intelligent field guide to such endangered species as Smithfield ham, Kentucky moonshine and country fair prize-winning apple pie.*"—New York Times

"*Passionate and literate.*"—Smithsonian

"*If you care about American cooking, as I do, you will find* Fading Feast *an enormously rewarding book.*"—Craig Claiborne

On an unusual mission for *Natural History*, Raymond Sokolov crisscrossed America over the past few years in search of vanishing regional foods. From Puget Sound to Key West, Sokolov found old chefs and cooks who still practice early American customs in preparing traditional food. He talked with them, collected their recipes (over 100 are included) and preserved the culinary wisdom of our American Past.

The culmination of Sokolov's odyssey is now gathered into a beautifully illustrated, hardcover book that has been widely acclaimed. These stories first appeared in Solokov's popular food column in *Natural History*, and additional recipes have been added.

A special offer: Members of the American Museum of Natural History may purchase *Fading Feast* at a 20% discount off the list price.

☐ Yes, I would like to order __________ copies of *Fading Feast*
at $17.95 - 20%, or $14.36 each. Please add $1.50 shipping and handling per order.
☐ Check Enclosed ☐ Please bill my credit card account below
Credit Card (circle one): MASTERCARD VISA
Account No: __________ Expiration Date: __________
Signature: __________
Name __________
Address __________
City __________ State __________ Zip __________
Mail to: *Natural History*, Central Park West at 79th Street, New York, NY 10024. Please allow 4 to 6 weeks for delivery.

Better Than Jogging

NordicTrack

Jarless Total Body Cardiovascular Exerciser

Duplicates X-C Skiing for the Best Motion in Fitness

Highly Effective and Pleasant To Use
The enjoyable sport of cross-country skiing is often cited by physiologists as the most perfect form of cardiovascular exercise for both men and women. Its smooth, fluid, total body motion uniformly exercises more muscles and higher heart rates seem easier to attain than when jogging or cycling. NordicTrack closely simulates the pleasant X-C skiing motion and provides the same cardiovascular endurance-building benefits — right in the convenience of your home. Makes a year round, consistent exercise program easily attainable. Eliminates the usual barriers of time, weather, chance of injury, etc. Also highly effective for weight control.

Better Than Running
NordicTrack gives you a more complete work out — conditions both upper body and lower body muscles at the same time. Fluid, jarless motion will not cause joint or back pains as jogging or running often does.

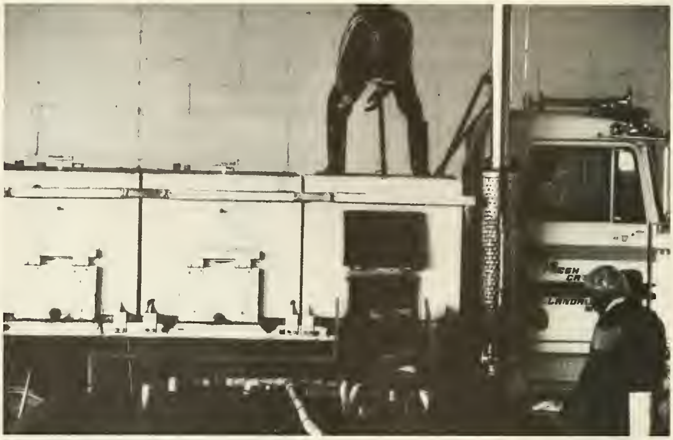
Better Than Exercise Bikes
NordicTrack's stand-up skiing motion more uniformly exercises large leg muscles and also adds important upper body exercise. Higher pulse rates, necessary for building fitness, seem easier to attain because the work is shared by more muscle mass. The NordicTrack also keeps more muscles in tone.

Even Better Than Swimming
NordicTrack more effectively exercises the largest muscles in the body, those located in the legs and buttocks. These muscles' main function is to lift and propel the body in the standing position. However, when swimming, the body is supported by the water, thus preventing these muscles from being effectively exercised. The stand up exercising position on the NordicTrack very effectively exercises these muscles.

A Proven, High Quality Durable Product
Ruggedly constructed, NordicTrack is quiet, motorless and folds compactly for storage. Separately adjustable arm and leg resistances. NordicTrack is in its 5th year of production and is used in thousands of homes and many companies. We manufacture and sell direct. Our No-Risk 15 day trial guarantee shows our confidence in your being pleased with the performance and quality of the NordicTrack.

For more information, call or write
PSI 124 L Columbia ct. Chaska, MN 55318
toll free 1-800-328-5888 8 – 5 Mon – Fri
Minnesota 612-448-6987

Pond-bred catfish are loaded live from trucks into holding tanks.



served with those tangy little spheres of fried cornmeal batter called hush puppies—that is how I had previously eaten catfish all over the South and particularly on one spectacular occasion at a river restaurant in De Vall's Bluff, Arkansas.

This trip we passed all manner of fast catfish shacks and brand new, gaudily nautical, all-you-can-eat catfish palaces, finally rolling to a stop in front of a white hulk of a building by a wooded stream. Ruben's is only a two-minute drive outside of Columbia, Mississippi, but it is all by itself, so isolated and wet and green that you think you have escaped civilization as completely as Huck.

For $6.95, you get all the perfectly crisp and angelically sweet, unfilleted, plate-sized whole catfish you can swallow. They come with hush puppies, and the salad bar offers, among other delicacies, stinging jalapeño peppers. There is beer, and service is swift and friendly.

I would have been happy even if the service had been rude and there'd been no salad bar at all. The catfish was enough, with its fine, sweet, dense white flesh and minimal bony structure. The simplicity of the setting should not deceive anyone who can see beyond surface and who has a taste bud or two. The refinement of the fish's texture contrasts with the nubbly, brittle texture of the fried cornmeal exterior. The hush puppies are sharply seasoned and add a solidity to the meal somewhere between mashed potatoes and rice. *Poisson-chat à l'américain* is a first-rate culinary notion. And at Ruben's the catfish is impeccably fresh. Farm fresh.

I asked where their fish were coming

Fish are dumped into metal tubs and stunned with an electric charge.

from, expecting to be sent to a commercial fisherman. Instead the manager talked about a farm near Belzoni.

Catfish lend themselves almost ideally well to aquaculture. A farmer in Mississippi with plenty of flat land is in a splendid position to dig a pond and stock it with fingerlings. If he feeds them with a high-protein grain mixture, just like other livestock raised in confinement, he can produce a pound of salable catfish with every 1.7 pounds of feed. This is a superbly efficient ratio. By one estimate, it takes 2.1 pounds of feed to raise a pound of chicken. Six pounds of feed convert to 1 pound of pork. With beef, the ratio is something like 8 to 1.

Catfish, according to Larry Joiner, general manager of the Farm Fresh Catfish Company's processing plant in Hollandale, Mississippi, adapt well to ponds. They are hardy, disease resistant, and can tolerate wide variations in water temperature. Farm Fresh has located in Hollandale and elsewhere in the South, because the fish grow better in warm weather, because the traditional catfish market is there, and because abundant water and flat land make the job relatively simple.

Farm-raised fish may actually be an improvement over their wild, bottom-feeding cousins. They are what they eat, say their proponents, who assert that river catfish often pick up a musty, nasty flavor from their foraging in the mud upon carrion. Farm-raised fish eat grain that floats. I am not going to take sides in this dispute without further research. At the moment, I am only going to say that I have never eaten a well-cooked catfish I didn't like. Wild or pond bred, they were all delicious. But the future does seem to lie with pond catfish like those I saw loaded live from trucks into the concrete holding tanks at Farm Fresh in Hollandale.

Ninety percent of these fish are sold to the restaurant trade. Fast catfish restaurants are a growth business in the South now that the supply of good, cheap fish has made a fish dinner a cheap alternative to roadside chicken. Aquacultured fish can, moreover, be supplied in whatever size the restaurateur prefers. A processing plant, such as one I visited, can easily sort fish electronically by two-ounce weight increments. A sensor hooked up to the conveyor belt weighs each fish and communicates the weight to a series of automated bats. When the fish pass the bat assigned to their weight class, the computer triggers the bat, which knocks the fish into a container full of fish of similar weight. Lighter and heavier fish are knocked by other bats into the appropriate containers for their weights.

Such precision is crucial for restaurant sales, because it allows Farm Fresh to supply large batches of fish all the perfect size to fill a customer's plate. You might say that modern aquaculture produces "naturally" portion-controlled, whole catfish, thereby making it possible for entrepreneurs to turn a handy profit with a folkloric dish prepared under hypermodern conditions.

All of us who are dedicated to preserving traditional foods, as well as to high quality in public feeding at a low cost that ordinary people can afford, ought to applaud a sensible new wrinkle such as catfish farming. Cheap, plentiful, savory complete protein is something everyone needs, especially when it comes with hush puppies on the side.

Raymond Sokolov's new book, Fading Feast *(Farrar, Straus and Giroux), is a collection of food columns that first appeared in* Natural History.

BIRD'S-EYE VIEW

Designed in collaboration with internationally famous ornithologists, Swift's Audubon and Osprey binoculars give you a superior combination of performance and durability.

The 8.5x,44 AUDUBON Wide Angle is tops in the field — with an extra-wide field of view (445 feet), crisp close focusing to 13 feet, and hairline definition.

The 7.5x,42 OSPREY is distinguished by its rubber armor protection and slip-on rainguard that eliminate the need for a cumbersome case and allow it to be used safely in virtually any weather conditions. Close focusing to 13 feet.

For technical excellence and enduring quality, Swift binoculars are the natural choice.

OSPREY MK. II
weather-protected
binocular

SWIFT®

TECHNICAL EXCELLENCE
ENDURING QUALITY

For More Information: SWIFT INSTRUMENTS, INC., 952 Dorchester Ave., Boston, MA 02125 or P.O. Box 562 San Jose, CA 95106

Two recipes from *Four Great Southern Cooks*, DuBose Publishing, P.O. Box 924, Atlanta, GA 30301

William Mann, Jr.'s Fried Catfish

12 small to medium catfish
Salt
Freshly ground black pepper
White cornmeal
Vegetable shortening for deep frying

1. Fillet the catfish, leaving the skins on. Wash and pat thoroughly dry with a clean dish towel. Score the flesh side of the fish with a sharp knife; this will prevent curling while cooking.
2. Salt the fish lightly, sprinkle with pepper to taste, and dredge in the cornmeal.
3. Melt enough shortening to fill a heavy skillet to a depth of ½ inch. Heat the oil until it just begins to smoke. Then add the fish and fry for about five minutes on each side or until a light golden brown. Drain on paper towels and serve immediately.

Yield: 4 servings

Ruth Jenkins's Hush Puppies

1½ cups white cornmeal
½ cup flour
1 teaspoon salt
1 teaspoon baking powder
½ teaspoon baking soda
¾ cup buttermilk
1 egg, beaten
½ teaspoon Tabasco
½ cup finely chopped onion
Vegetable oil for deep frying

1. In a small bowl, mix the cornmeal, flour, salt, baking powder, and baking soda. Stir in the buttermilk, egg, Tabasco, and onion.
2. In a heavy saucepan, heat enough vegetable oil for deep frying. Form the batter into rounded tablespoons and drop into hot oil (375 degrees). Fry only until light brown. Drain on paper towels and serve hot.

Yield: About 24 hush puppies

Ca Kho To

(Vietnamese simmered fish, adapted from a recipe in *The Classic Cuisine of Vietnam*, by Bach Ngo and Gloria Zimmerman, Barron's)

3 tablespoons plus 1 teaspoon sugar
A few drops lemon juice
Freshly ground black pepper
2 slices catfish (about ½ pound)
3 tablespoons fish sauce (see note)
1½ tablespoons vegetable oil
3 cloves garlic, peeled and chopped
5 shallots or white part of 5 scallions, peeled and sliced
2 ounces pork fat, sliced ½ inch thick, then cut into 2- by 1-inch rectangles

1. Put 1 tablespoon of the sugar and 1 tablespoon plus 1 teaspoon of water in a small pan. Cook over high heat until the sugar turns dark brown and you see steam forming. Stir well, remove from heat, and add 2 tablespoons plus 2 teaspoons water. Return to heat, stir constantly, and cook for about 5 minutes. Stir in lemon juice, giving a few quick stirs and remove from heat. Set aside.
2. Sprinkle black pepper over the fish slices. Put them on a plate, pour the fish sauce over them, then sprinkle with remaining (2 tablespoons plus 1 teaspoon) sugar.
3. Heat 1 tablespoon oil in a small saucepan. Fry the garlic for a few seconds, then add two-thirds of the shallot or scallion slices; stir and add the pork. Stir briefly and add the fish slices.
4. Turn the fish in the oil, back and forth, from one side to the other, to coat with oil and to sear. Do this for about three minutes.
5. Add any liquid in the plate used for marinating the fish. Then add the caramelized sugar from step 1.
6. Reduce heat and simmer slowly, covered, for 10 minutes.
7. While the fish simmers, heat the remaining (1½ teaspoons) oil in a small saucepan and brown the remaining shallot or scallion slices. After fish has simmered for 10 minutes, add the browned shallot or scallion slices and simmer uncovered for another 10 minutes, or until about half the water has evaporated.

Yield: 4 servings

Note: The fermented fish sauce called nuoc mam is the fundamental condiment of Vietnamese cuisine. It can be found in Oriental groceries, often under the Squid Brand label. Purists of Viet cuisine shun bottled fish sauces produced for Chinese or Philippine cooking but will accept nuoc mam manufactured in Hong Kong or Thailand, especially if it has the words nhi (highest quality) and/or Ca Com (signifying an elite, all-anchovy-based sauce) on the label.

FISH
BUFFALO 55
DRESSED CAT
DRESSED CAN
MAGNOLIA STATE

Local specialties are posted outside a fish store.

FOR PEOPLE
WHO ACTUALLY
BELIEVE A CAR'S
PRICE SHOULD
BEAR SOME
RELATIONSHIP
TO ITS WORTH.

There are, fortunately, still some people in the world who can discern the difference between a car that's worth the money and one that's outrageously overpriced.

If you're one of them, you'll appreciate the Volvo GL.

It's an automobile that not only exhibits extraordinary workmanship and care of construction. It abounds in the refinements you'd expect in a fine prestige car: air conditioning, sun roof, power windows, orthopedically-designed front bucket seats, and a driver's seat that automatically heats up when the temperature falls below 57°. (All of these things, incidentally, are standard.)

In one place, and one place only, does the Volvo GL fall short of other select imported luxury cars. In price.

Which simply means it's now possible for you to purchase a fine European luxury sedan.

Without being taken for a ride.

VOLVO

A car you can believe in.

© 1981 VOLVO OF AMERICA CORPORATION. ELECTRIC SIDE MIRRORS OPTIONAL.

hexa·photo·cybernetic
The Possibilities are Endless.

Six-mode exposure control. System versatility. Newer electronics for wider applications.

SHUTTER PRIORITY AE
PROGRAMMED AE
ELECTRONIC FLASH AE
MANUAL
STOP-DOWN AE
APERTURE PRIORITY AE

The Canon A-1 is one of the world's most advanced automatic SLR cameras. Combining the finest in optical and mechanical engineering with the most sophisticated electronics, it's technology applied to give you the ultimate in creative control. At the touch of a button.

Depending on your subject, you can choose from six independent exposure modes to achieve the results you want:

1 Shutter-Priority: You select the shutter speed, to freeze the action and prevent camera shake or create an intentional blur. The A-1 automatically selects the appropriate lens opening.

2 Aperture-Priority: Control the area in focus by selecting the lens opening for the effect you want. The A-1 matches with the right speed.

3 Programmed: When you need to shoot fast, just focus. The A-1 will select *both speed and aperture* for great results.

4 Stopped-Down: For extreme close-up or specialized photography, a bellows, a microscope or almost anything can be attached to the A-1. It's still automatic.

5 Flash: Totally automatic flash photography, of course, with a wide variety of Canon Speedlites to choose from.

6 Manual: Yes. For those times when you absolutely want to do it all yourself. To experiment. To explore the possibilities.

Canon
A-1
CANON LENS MADE IN JAPAN
CANON LENS FD 50mm 1:1.8

Shutter-Priority: 1000 5.6

Canon
Canon

There are over forty fine Canon lenses ranging from Fish Eye to Super Telephoto, plus accessories to meet every need. If you can't photograph your subject with a Canon A-1, it probably can't be photographed.

From the sophistication of its LED viewfinder display, to a ruggedness that allows up to five-frame-per-second motor drive; the Canon A-1 represents an incredible technology. At a price that makes owning one a definite possibility.

Canon A-1

Canon USA, Inc., One Canon Plaza, Lake Success, New York 11042 • 140 Industrial Drive, Elmhurst, Illinois 60126 • 6380 Peachtree Industrial Blvd., Norcross, Georgia 30071 • 123 Paularino Avenue East, Costa Mesa, California 92626 • Bldg. B-2, 1050 Ala Moana Blvd., Honolulu, Hawaii 96814 • Canon Canada, Inc., Ontario.

©1981 Canon U.S.A., Inc.

NATURAL HISTORY

$2

8/82

WE'RE SHAPING OUR CARS FOR
AND LESS FRICTION

Overcoming the wind. It's absolutely critical to achieve good mileage.

At 55 mph, over half of a car's fuel is used just to overcome aerodynamic drag.

Aerodynamics.

At GM, we've put millions of dollars into aerodynamic research. That includes everything from modifying the overall shape of our cars to scrutinizing details like the angle of the outside mirrors.

GM is the only manufacturer in the U.S. with its own full-scale automotive wind tunnel—and it is the most advanced. It gives us an opportunity to build the most aerodynamic cars in the world.

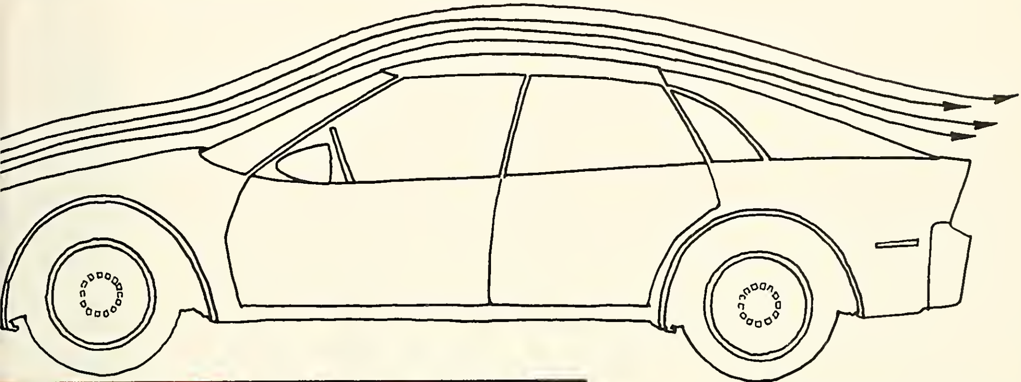
Great gas mileage.

The aerodynamic efficiency of a five-passenger concept vehicle developed in our wind tunnel improved potential mileage by five miles per gallon.

Our aerodynamic know-how, which is being applied to GM cars today, has contributed to the 100% mileage improvement our cars have achieved in the last eight years.

WE'RE THE B

LESS DRAG ON YOUR WALLET, AT THE GAS PUMP.



Great looks.

Aerodynamically designed cars look terrific. Sleek, sophisticated and elegant.

Corners are rounded, surfaces are smooth, trim is minimized. Great mileage married to great appearance.

A new kind of excellence.

We believe that GM stands for something special in the eyes of the American public.

It stands for excellence.

And continuing excellence. So that now, next year, and the years after that, we need always to be:

the best GM ever.

GM
MARK OF EXCELLENCE

Chevrolet
Pontiac
Oldsmobile
Buick
Cadillac
GMC Truck

EST GM EVER

THE NATURAL WONDERS OF KENYA

The foothills of snow-capped Kilimanjaro to the acacia dotted savannah plains of the Serengeti… the awesome escarpments and flamingo covered soda lakes of the Great Rift Valley to the majestic peaks of Mt. Kenya represent but a few of the spectacles that create the magnificence of East Africa. The feeling of the tented camp immersed in the open air and sounds of the wild creates a genuine safari atmosphere never to be forgotten. With the romance of the "Dark Continent" as our stage, we would like to invite you to join us in the drama of a truly incredible safari adventure.

International Expeditions, Inc.
Suite 104
1776 Independence Court
Birmingham, Alabama 35216
(205) 870-5550
TOLL FREE 1-800-633-4734

(ALL INCLUSIVE FROM NEW YORK) **19 DAY SAFARI – $2350**

1982 Departure Dates: September 7, September 28, October 19, November 9, November 30

AFRICA

EAST AFRICAN ORNITHOLOGICAL SAFARIS LTD.

PAN AM

NATURAL HISTORY

Vol. 91, No. 8, August 1982

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director
David D. Ryus, Vice-President

4 Authors

6 Numbers Large and Small *Isaac Asimov*
All those zeroes can be a chain around your mind.

12 This View of Life *Stephen Jay Gould*
Free to Be Extinct

18 The Great Amateur of Archeology *John Fowles*
A love of natural history and antiquities combined to form John Aubrey's greatness.

26 Et tu, Tree Shrew? *Robert D. Martin*
Successful maternal care takes only a few minutes every two days.

34 Fossils of the Libyan Sahara *Noel T. Boaz and Douglas L. Cramer*
Once-lush North Africa—now a desert—probably was home for an early hominid.

42 In Search of Past Harmony *Joseph L. Sax*
In France, human occupants are an integral part of historic regional parks.

52 Desert-nesting Sea Gulls *Thomas R. Howell*
Why do gray gulls choose the Chilean desert, one of the most inhospitable places on earth, to raise their young?

60 Books in Review *Gerald Carson*
The Last Grand Victorian Expedition

64 Sky Reporter *Stephen P. Maran*
Inside Jupiter's Rings

70 At the American Museum
Quarrying the Museum

74 Celestial Events *Thomas D. Nicholson*

76 Additional Reading

78 A Matter of Taste *Raymond Sokolov*
Quince Essentials

Cover: *The coast of Corsica near the village of Porto is part of a French regional park. The tower was built during the fifteenth century to protect the island against pirates. Photograph by Bruno Barbey; Magnum. Story on page 42.*

Alan Ternes, Editor
Judith Friedman, Managing Editor
Thomas Page, Designer
Board of Editors: Carol Breslin, Sally Lindsay, Frederick Hartmann, Vittorio Maestro, Rebecca B. Finnell
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
E. Kay Danzig, Art Asst.
Kay Zakariasen, Picture Editor
Douglas J. Preston, Publications Mgr.
Annie R.C. Finch, Editorial Asst.
Lillian Berger

L. Thomas Kelly, Publisher
Bradford D. Smith, Business Manager
Frederick E. Grossman, Production Mgr.
Debra Buck McCord, Asst. Production Mgr.
Ernestine Weindorf, Administrative Asst.
Elaine M. Callender, Advtg. Production Mgr.
Carol A. Midkiff

Cary Castle, Circulation Manager
Jeff Pieper, Assoc. Circulation Mgr.
Ramón E. Alvarez, Asst. Circulation Mgr.
Frank Stevens, Circulation Asst.

NATURAL HISTORY *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024.*
Subscriptions: $15.00 a year. In Canada and all other countries: $20.00 a year. Second-class postage paid at New York, N.Y. and at additional offices. *Copyright © 1982 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of* Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.* Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225

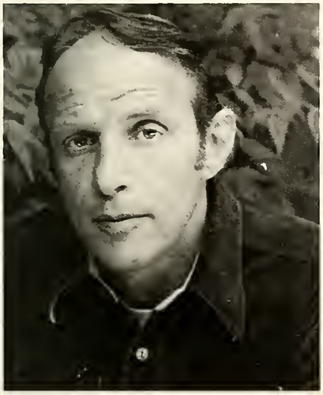
Subscription orders, change of address notices, undeliverable copies, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

Authors

Robert D. Martin is a mediocre squash player, a poor swimmer, and is fluent in French and German. In spite of this mixed bag of talents, he is a first-rate primatologist. He has conducted numerous field studies on the behavior, ecology, and evolutionary biology of primates in such disparate locales as Brazil, South Africa, Panama, and Madagascar. One of his upcoming projects is a comprehensive analysis of reproductive variables and brain development in primates, aimed at identifying evolutionary trends. Martin's last article for *Natural History*, "Radio Bush Baby," appeared in the October 1979 issue.

When a treatise on elephant evolution provided a tentative age for Sahabi, a paleontological site in Libya, **Noel T. Boaz** (right) recognized that the locality held potential significance for researchers in early human evolution. The International Sahabi Research Project was formed to explore this possibility. As director, Boaz has alternated in the past few years between collecting specimens in the desert and analyzing the results at the Paleoanthropology Laboratory at New York University, where he is an assistant professor of anthropology. Boaz holds a Ph.D. from the University of California at Berkeley, where his research focused on the paleoecology of hominids in the Lower Omo Basin in Ethiopia.

Coauthor and illustrator **Douglas L. Cramer** (left) received his Ph.D. in physical anthropology from the University of Chicago. An assistant research professor in cell biology at New York University and director of the Human Gross Anatomy Laboratory at the university's School of Medicine, Cramer became involved in the Sahabi Project in 1981. In addition to surveying for fossils at Sahabi, Cramer served as the expedition's chief mechanic and took photographs. Trained and experienced in medical and biological illustration, Cramer has done the artwork for a number of other *Natural History* articles, most recently "The Late, Great Sabertooths" this past April.



A professor of law at the University of Michigan's Law School, **Joseph L. Sax** specializes in questions relating to the management of public lands, with special emphasis on parks and wilderness areas. As a frequent visitor to France, Sax became aware of how little Americans attended to the innovative ideas of European park managers. He says, "We have not really 'seen' the natural areas of Europe, having been 'blinded' by castles, churches, and restaurants." In the last three years, Sax has made it a special point, whenever he is in Europe, to explore the parks of whatever region he is in. A graduate of Harvard University, he received his law degree from the University of Chicago.

Thomas R. Howell, a professor of zoology at the University of California at Los Angeles, first heard of the unusual desert breeding habits of South America's gray gull more than thirty-five years ago but had to wait more than twenty before he could travel to the Atacama Desert in Chile to investigate for himself. His interest in the reproductive biology of birds has taken him to locations as far apart as Ethiopia—where he studied the Egyptian plover, which dips its feathers in water to cool its eggs—and Midway Island in the Pacific—where he investigated nesting red-tailed tropicbirds, strong fliers that have virtually lost the ability to walk. Howell also studies the taxonomy and distribution of birds in the New World tropics, particularly Nicaragua.

INDIA.
EXPECT THE
UNEXPECTED.

Climb to the top of the world.

Our people are most interesting and most friendly

Your hotel could be a lovely houseboat.

"Suppose a thousand suns should rise together into the sky: such is the glory of the shape of the infinite."

Bhagavad-Gita

What you expect in India will astonish you. What you have not expected could be a turning point in your life.

Perhaps it will be the massive Konarak Temple, dedicated to the Sun God.

Or the majestic Himalayas.

It might be something as simple as the smiling eyes of our people.

Our fascinating cuisine.

Or that we have the most marvelous places for you to stay.

In India you will find a different world. An unexpected world. See your travel agent.

UNBELIEVABLE
INDIA

Please send me information on Unbelievable India NH-8

Name

Address

City, State, Zip

GOVERNMENT OF INDIA TOURIST OFFICE
30 ROCKEFELLER PLAZA, NEW YORK N Y 10112 (212) 586-4901
3550 WILSHIRE BLVD . LOS ANGELES, CA 90010 (213) 380-8855
523 37TH AVE , SAN FRANCISCO, CA (415) 386-8284
230 N MICHIGAN AVE CHICAGO, IL 60601 (312) 236-6899
POST BOX 342 T D CENTRE, TORONTO, CANADA (416) 362-3188
MIAMI, FLA (305) 944-7039 DALLAS, TEXAS (214) 234-2233

Numbers Large and Small

Scientists rely on an unambiguous mathematical shorthand to express both the immense and minuscule values with which they work

by Isaac Asimov

In the scientific investigation of the universe, very large and very small numbers inevitably have to be used because we are dealing, on the one hand, with inconceivable immensity and, on the other, with equally inconceivable minuteness. There are, perhaps, as many as 10,000,000,000,000,000,000 stars in the universe, and a typical star, such as our sun, has a mass of 2,000,000,000,000,000,000,000,000,000,000,000 grams. A light-year is 9,460,000,000,000,000 meters long. On the other hand, a proton is about 1/10,000,000,000,000 of a centimeter across and has a mass of 5/3,000,000,000,000,000,000,000,000 of a gram.

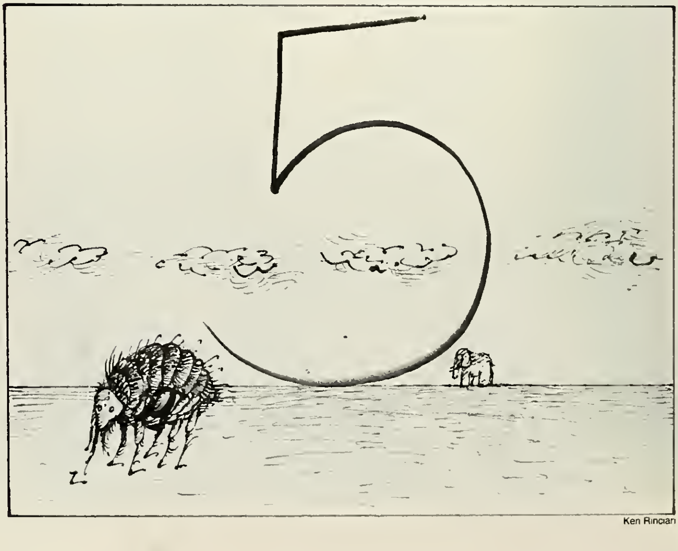
Trying to handle numbers with such long chains of zeroes gets pretty tiresome and is entirely a modern problem. In prehistoric times, human beings were so circumscribed they had no need for large numbers. There are primitive tribes, even today, with very few number words. One hears of some tribes that have names equivalent to only "one" and "two." For any number over two, they will speak of "many." This doesn't mean, of course, that members of such tribes are incapable of recognizing three objects or four. They just don't have special names for such numbers and they can get along with what they have. If a member of such a tribe lends a friend "two and two more" of an object, he will know the difference and be seriously annoyed if he gets back only "two and one more."

As a matter of fact, in ancient and medieval times, our ancestors did not do very much better. They had only twelve different number names, and all the many numbers that were used were built up out of those twelve. Ten of the different number names were and still are, naturally, for the first ten numbers: one, two, three, four, five, six, seven, eight, nine, ten. (These are the labels in English, of course; every language has its own names.) Presumably, we had ten different names because we have ten fingers, and if we match numbers against fingers, it is only natural to give each finger a different name.

Beyond that we have derived names. Eleven is a distortion of an Anglo-Saxon expression that corresponds to "one left" in modern English—one left, that is, after ten have been counted off, making a total of eleven. In the same way, twelve is "two left." Thirteen is a distorted form of "three and ten"; twenty a distorted form of "two-tens." With those appellations in mind, we can see the meaning of any given number in terms of the basic ten, up to ninety-nine ("nine tens and nine").

Following this system, the number after ninety-nine would be tenty, and after tenty-nine we would have eleventy, and so on. Children, recognizing the logic behind this, sometimes make use of such number names but are quickly corrected by their elders, who know that the number after ninety-nine is one hundred. The name "hundred" has its origins back in prehistory as does "thousand," which comes after "nine hundred ninety-nine." Hundred and thousand are the two remaining number names that are of early origin. The Roman word for thousand was mille, from which is derived our "mile," which was originally a thousand paces in length.

People can use numbers well beyond one thousand, of course, without having to make up new names. We can speak of ten thousand or nine-hundred thousand or a thousand thousand, for that matter. The Greeks had a word, *myrios*, meaning "innumerable," and from this they formed


Ken Rincian

Adapted from *Exploring the Earth and the Cosmos*, by Isaac Asimov. Published by Crown Publishers, Inc. Copyright © 1982 by Isaac Asimov.

the word *myrias* and set it to mean "ten thousand." We get our word "myriad" from the Greek term and use it to mean "a very great number," although on rare occasions someone may use it to designate precisely "ten thousand."

The Greek mathematician Archimedes wrote a treatise intending to show that the number system could be used to enumerate any quantity, however large, and to do so he used the scheme of talking of myriads of myriads of myriads—he did not try to simplify matters by inventing a name for a number larger than a myriad. But in the late Middle Ages in Italy, commerce and wealth grew to the point where, in bookkeeping, it became necessary to speak with considerable frequency of a given number of thousand thousands. The Italian merchants found it useful to invent a special word for "thousand thousand." They called it *milione*, meaning "a large mille"—that is, "a large thousand." In English the name is "million." (At about the same time, Arabic numerals were coming into widespread use and the symbols 1,2,3,4,5,6,7,8, and 9 were adopted.)

The use of million had become general in Europe by the 1500s and, by that time, a still higher number-word had also come into use. The fifteenth-century French mathematician Nicholas Chuquet was the first to use "billion" for "million million." The prefix "bi" is from the Latin *bis*, meaning "twice." Billion is a number, in other words, in which "million" appears twice.

In Arabic numerals, one hundred is 100, one thousand is 1,000, and one million is 1,000,000. If one billion is one million million, it is written 1,000,000,000,000. That is the meaning of one billion in Great Britain and Germany today. In the United States and France, however, one billion has come to be used for one thousand million, or 1,000,000,000. Once bil-

Coonhound
PUPS FOR
SALE
5-E689
If you'd like a booklet that tells you more about our tour, drop us a note.

IN MOORE COUNTY, you can buy everything from Tennessee hams to Tennessee hounds. But never Tennessee Whiskey.

Surprisingly, the county where we make Jack Daniel's is dry. So even if we wanted to sell our whiskey here, the sheriff wouldn't go along. Still, we think you'll enjoy a tour through our distillery and a stroll through our town. Just drop in anytime. You'll learn a lot about good whiskey. And you might latch on to a pretty fair dog.

CHARCOAL
MELLOWED
DROP
BY DROP

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery
Lem Motlow, Prop., Inc., Route 1, Lynchburg (Pop. 361), Tennessee 37352
Placed in the National Register of Historic Places by the United States Government.

lion was well established, still other words were coined, making use of Latin prefixes for three, four, five, six, and so on. We therefore have words such as trillion, quadrillion, quintillion, sextillion, septillion, and octillion.

In American usage, each of these names is a thousand times the value of the one before, so that a trillion is a thousand billion (1,000,000,000,000), a quadrillion is a thousand trillion (1,000,000,000,000,000), and so on. In British usage each of these names is a million times the former, so that a trillion is a million billion, or a million million million (1,000,000,000,000,000,000); a quadrillion is a million trillion (1,000,000,000,000,000,000,000,000).

In this system, the largest number name ordinarily met with is centillion. The prefix is from the Latin *centum*, meaning "hundred," so that centillion in the American system has a hundred groups of three zeroes in addition to the basic three for thousand and is therefore a 1 followed by 303 zeroes. In the British system it would be a 1 followed by 600 zeroes.

New large number names to any indefinite extent could be easily invented, but there is no need to do so, for scientists have devised a much more sensible and convenient system for referring to large numbers. In the seventeenth century, the French mathematician René Descartes grew tired of representing repeated multiplications of a particular number or symbol such as $a \times a$, or $a \times a \times a$. He preferred to represent such products as a^2 and a^3. The figure above the line is called an "exponent" and such "exponential notation" came into general use in the seventeenth century.

Since $10 \times 10 = 100$, and $10 \times 10 \times 10 = 1{,}000$, it is possible to refer to 100 as 10^2 and to 1,000 as 10^3. Following this system, 10,000 is 10^4; 100,000 is 10^5; 1,000,000 is 10^6, and so on. What makes the system easy to remember and use is that the exponent represents the number of zeroes after the 1 in such numbers. Thus we know at once that 10,000,000,000,000 is 10^{13} and that 10^{17} is 100,000,000,000,000,000. Again, once we define a centillion as a 1 followed by 303 zeroes, in the American system, we also know it is 10^{303}. In the British system, it is 10^{600}. While there is a chance for confusion in using the number names, since all the number names higher than a million signify different values in different nations, exponential notation is generally agreed on everywhere and there is no ambiguity.

Exponential notation can be used for numbers generally. Thus, 6,300 can be written as 63×100, or $6.3 \times 1{,}000$, or even $0.63 \times 10{,}000$. It can also be written as 63×10^2, or 6.3×10^3, or 0.63×10^4. Each of these alternatives is correct, but it is customary to choose the one in which the nonexponential portion of the figure is between 1 and 10. Therefore, 6,300 should be written as 6.3×10^3.

In writing or thinking of large numbers, we can easily see that there is no way of writing or thinking of such a thing as "the largest number." Any number you can have the patience to write or to think of can always have 1 added to it, or it can always be doubled, or it can always have a group of zeroes added to it. The early Greek mathematicians must have understood this, but it was not until late medieval times that mathematicians began to deal with unending series of numbers that grew steadily larger and never stopped increasing.

In 1202, for instance, the Italian mathematician Leonard Fibonacci first introduced what is now called the Fibonacci series. This is a sequence of numbers beginning with 1,1, where each number is the sum of the two preceding. The sequence, then, is: 1,1,2,3,5,8,13,21,34,55,89, and so on, forever. This is an unending series of numbers, or an "infinite series," where "infinite" derives from a Latin word meaning "unending." By the 1680s, when the English mathematician Isaac Newton introduced a branch of mathematics called the calculus, infinite series played an exceedingly important role and the question of how to symbolize them became important. Mathematicians, writing hurriedly, needed a compact symbol to express "and so on, forever."

In 1656, English mathematician John Wallis used a sideways 8 as the symbol. If we write $1,2,3 \ldots \infty$, we mean the sequence is viewed as being continued forever. The symbol ∞ means "and so on, forever," or "and so on, endlessly," or "and so on, infinitely." The symbol is also often read as "infinity," meaning "endlessness," and there is a strong temptation to consider it a number; specifically, the largest number there is. That, however, is wrong. The symbol ∞ is not a number but a characterization of the property of endlessness.

Actually, there are different degrees of endlessness. Thus we might think we could count anything by the use of the sequence of natural numbers—all the grains of sand on all the beaches of the world, all the stars in the sky, all the atoms in all the universe, all the seconds that the universe has existed—without exhausting the number system and without getting any closer to "infinity" than we were when we started. Yet not so. In 1874, Georg Cantor, a German mathematician, was able to show that there was no way of counting all the points in a line, for instance. No matter what system was used to count them, an infinite number of them were always omitted. The entire endless series $1,2,3 \ldots \infty$ did not suffice to count them.

This meant that the infinite number of points in a line represented a higher order of infinity than the infinite number of numbers in the $1,2,3 \ldots \infty$ sequence. In fact, Cantor showed that it was logical to suppose that there was an endless series of orders of infinity, of which the endlessness of the counting numbers was the very least.

Moving off in the other direction, we can ask how *small* can numbers become? If we deal only with the natural whole numbers, $1,2,3 \ldots \infty$, then 1 is the smallest number. We can't very well have fewer pebbles than one, for instance. Except that we can. Smaller and smaller numbers are created by subtraction. If we begin with 5 pebbles and take 1 away, we have 4. If we repeat the process, we have 3, then 2, then 1. But we can repeat the process once more, take away that one last pebble, and have none at all.

It might be argued that "nothing" is not a number, but mathematicians have found that if nothing is given a symbol, that symbol can be manipulated like any other symbol (except that it is impossible to divide by "nothing," so that the process is forbidden).

As far as we know, throughout ancient times no one ever thought of giving "nothing" a symbol. Without that symbol, however, no really useful system of number-symbols could be evolved. The Egyptians, Babylonians, Hebrews, Greeks, and Romans all used symbols that required clumsy manipulation and held back mathematics inordinately.

Thus, many ancients used the abacus to manipulate numbers, and to represent "one hundred two," they would have one counter in the hundreds column and two in the units column, but none in the tens column. They never thought of using a symbol to represent "none in the column."

The idea finally occurred to a mathematician in India (one forever nameless and unknown) some time before A.D. 876. The concept of "nothing" was represented by a little dot, as being the closest, still-visible approach to nothing, or as a little circle, which is just a hollow dot and therefore an even closer approach to nothing. We write it 0, so that a hundred two is written 102, with the 0 indicating the presence of "no counters in the tens column."

The Arabs borrowed the notion from

BOOK-OF-THE-MONTH CLUB®

America's Bookstore® since 1926

Facts About Membership

As a member you will receive the *Book-of-the-Month Club News®* 15 times a year (about every 3½ weeks). Every issue reviews a Selection and 150 other books that we call Alternates, which are carefully chosen by our editors. If you want the Selection, do nothing. It will be shipped to you automatically. If you want one or more Alternates—or no book at all—indicate your decision on the Reply Form and return it by the specified date. *Return Privilege*: If the *News* is delayed and you receive the Selection without having had 10 days to notify us, you may return it for credit at our expense. *Cancellations*: Membership may be discontinued, either by you or the Club, at any time after you have purchased 4 additional books. Join today. With savings and choices like these, no wonder Book-of-the-Month Club is America's Bookstore.

Book-of-the-Month Club, Inc., Camp Hill, Pennsylvania 17012

Please enroll me as a member of Book-of-the-Month Club and send me the set I have checked below, billing me for the appropriate amount, plus shipping and handling charges. I agree to buy 4 books during the next two years. A shipping and handling charge is added to each shipment. **A113-8**

Check one box only:

☐ 912. Compact OED **$24.95**
☐ 917. Ency. of Philosophy **$24.95**
☐ 943. Great Ladies of Song (11 Records) **$14.95**
☐ 946. Great Ladies of Song (6 8-Track Tapes) **$14.95**
☐ 913. The Story of Civ. **$29.95**
☐ 939. Museum/ Gallery Set **$17.95**
☐ 944. Great Ladies of Song (6 Cassettes) **$14.95**
☐ 947. Wildlife Series **$19.95**

Mr.
Mrs.______________________________ **2-64**
Miss (Please print plainly)

Address____________________ Apt._______

City______________________________

State____________________ Zip_______

Prices shown are U.S. prices. Outside the U.S., prices are generally higher.

Place
Stamp
Here

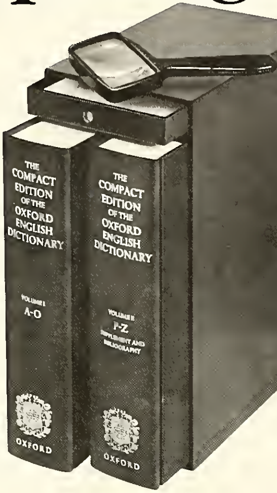
BOOK-OF-THE-MONTH CLUB®
Camp Hill, Pennsylvania 17012

Sets of permanent value at surprising savings.

The Encyclopedia of Philosophy

for **$24.95** (Pub price $150)

The most comprehensive encyclopedia of philosophy ever published, this set traces ancient, medieval, modern, Eastern and Western thought. An essential and rewarding reference source for home libraries.



The Compact Edition of The Oxford English Dictionary

for **$24.95** (Pub price $125)

The "most complete, most scholarly dictionary of the English language"—*The Christian Science Monitor.* Through photo-reduction, the original 13-volume set has been reproduced in this two-volume *Compact Edition.* Magnifying glass included.

The National Gallery of Art & The Metropolitan Museum of Art

for **$17.95** (Pub prices total $110)

The National Gallery of Art reproduces the gallery's greatest treasures with 1120 illustrations, including 1028 plates in full color, many printed with gold. *The Metropolitan Museum of Art* surveys the Met's entire collection, with more than 1050 plates (602 in full color).

Great Ladies of Song

for **$14.95** (Nonmember prices total $76.85)

Three Book-of-the-Month Club custom recordings: *Billie Holiday: Ain't Nobody's Business If I Do; Sarah Vaughan, American Singer; Ella Fitzgerald Sings Gershwin.* Available in records, 8-tracks or cassettes.

The Story of Civilization by Will and Ariel Durant

for **$29.95** (Pub prices total $307.45)

For almost half a century Will and Ariel Durant traced the continuity of world history—the religions and philosophies, the political and economic tides, the arts and sciences, the customs and conquests—to show the foundations of society today. A Book-of-the-Month Club exclusive for almost 50 years, the Durants' illustrated masterwork is history come alive.

Wildlife Habitat Series

for **$19.95**, 6 Vols.
(Pub prices total $113.70)

Six volumes from the award-winning series: wildlife of the polar regions, forests, islands, prairies and plains, rivers and deserts. More than 200 color photographs in each volume, along with maps, appendix and detailed glossary. A beautiful addition to the home library.

Choose one of these six sets and save up to $277^50

You simply agree to buy 4 books within the next two years.

BOOK-OF-THE-MONTH CLUB®
America's Bookstore® since 1926.

Book-of-the-Month Club, Inc., Camp Hill, Pennsylvania 17012

LOOKING FAR NORTH
THE HARRIMAN EXPEDITION TO ALASKA, 1899

WILLIAM H. GOETZMANN & KAY SLOAN

Join the leading Victorian savants John Muir, John Burroughs, G.K. Gilbert, C. Hart Merriam, George Bird Grinnell, and photographer Edward S. Curtis as they explore, chart and record the bounty of the last great American frontier. The authors "have managed to give an almost forgotten episode in the history of American exploration a large historical and even philosophical significance."
—*Henry Steele Commager*

"Travel adventure in the grand manner."—*Morgan Sherwood*

"A splendid book . . . I commend it to all interested in Alaska, great men, and adventure."
—*Guy R. Martin*

At your bookstore or send $17.95
plus $2.00 for shipping to:
625 Madison Ave., N.Y., N.Y. 10022

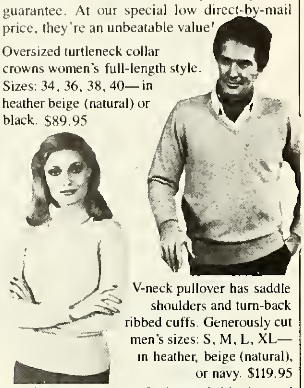
THE VIKING PRESS

Special Pre-Season Offer!

Pure 100% Cashmere Sweaters

TWO-PLY, FULL-FASHIONED

from $89.95 UNTIL SEPT. 1 Pamper yourself with cashmere—our incredibly soft, luxuriously warm American-knit sweaters of superb imported yarn. Order with complete confidence . . . on our 30-day money-back guarantee. At our special low direct-by-mail price, they're an unbeatable value!



Oversized turtleneck collar crowns women's full-length style. Sizes: 34, 36, 38, 40—in heather beige (natural) or black. $89.95

V-neck pullover has saddle shoulders and turn-back ribbed cuffs. Generously cut men's sizes: S, M, L, XL—in heather, beige (natural), or navy. $119.95

Add $3.50 per sweater for insured shipping and handling. N.Y. residents add sales tax.
For same-day shipment, call 800-221-2433 *toll-free* to order by VISA, MasterCard, or American Express. In N.Y., call 212-889-0033.
Or mail check with your order to:
SAMUEL LEHRER & CO., INC., Dept. HN-I
419 Park Avenue South, New York, N.Y. 10016.

DISCOVER
Spiegel

Our Chinese wedding basket lamp . . . the handwoven, painted basket base was traditionally used to exchange nuptual gifts. At $60 savings, it's a romantic way to discover Spiegel. (Order now and we'll send you our latest catalog.) Rust mushroom pleated fabric shade, brass coin finial. 3-way light. 24"H. Add $5 shipping. Regularly $119.95.
N66 EF 1028 . . . . **NOW 59.00**

Call us toll free and charge to your major credit card: 1-800-345-4500. Or send check to Spiegel, P.O. Box 7019, Chicago, IL 60680. Add sales tax in CA, IL, PA.
If you don't wish to order, but want our catalog, send $3 (applicable to your first purchase) to Dept. 270, Spiegel, P.O. Box 6340, Chicago, IL 60680.

the Indians and passed it on to Europe. The Arabs called the symbol *sifr*, meaning "empty" (the empty column in the abacus). From this we get "cipher" for working with numbers, or for something or someone that is of no account, or for a hidden message (that must be ciphered out). From *sifr* also comes "zero," our own name for the symbol 0. The cipher makes it possible to distinguish between 12, 102, and 120, for instance, and with its positional notation, made Arabic numerals far superior to anything that had gone before.

Zero may seem to be unquestionably the smallest number, since what can be smaller than nothing? But consider. Suppose you had no money and, in addition, owed someone a dollar. You would then have less than nothing for if, somehow, you earned a dollar you would have to give it away to cancel your debt. And, of course, you could have a debt larger than a dollar and therefore have less than nothing to an even greater degree.

We have "negative numbers" representing such debts, and we can write these as $-1, -2, -3 \ldots -\infty$, where these numbers are read "minus one," "minus two," "minus three," and so on. The first to recognize the general mathematical usefulness of negative numbers was the sixteenth-century Italian mathematician Girolamo Cardano.

Yet though negative numbers are less than nothing, they are not necessarily small numbers. If you owe a million dollars, you would have far, far less than nothing; but it would not appear to you as though you had very little money. It would appear to you as though you had a very large debt. It is more common to look upon small numbers as numbers that are very close to zero, whether on the positive or on the negative side. You may have very little money (though not none at all) or a very small debt (though not none at all).

This brings us to the concept of fractions. You can have one of an object, but if that object can be divided, then you can have half of an object or a quarter of it, and so on. If an object is divided into two equal pieces, then each piece is the result of one divided by two or, in modern symbols, 1/2 (where the slash represents divided by). Similarly, we can have 1/3 or 1/4 or 1/5, and so on. The greater the number of equal pieces into which you divide the original unit, the smaller the individual piece. Mathematically, a unit number can be divided into any number of pieces, generating the sequence $1/2, 1/3, 1/4 \ldots 1/\infty$.

Just as there is no such thing as a largest number in mathematics, so there is no such thing as a smallest number. The larger the number in the denominator (the figure to the right of the slash), the smaller the number, and since it is always possible to make the denominator larger, no matter how large it was to begin with, it is always possible to make the number smaller, no matter how small it was to begin with.

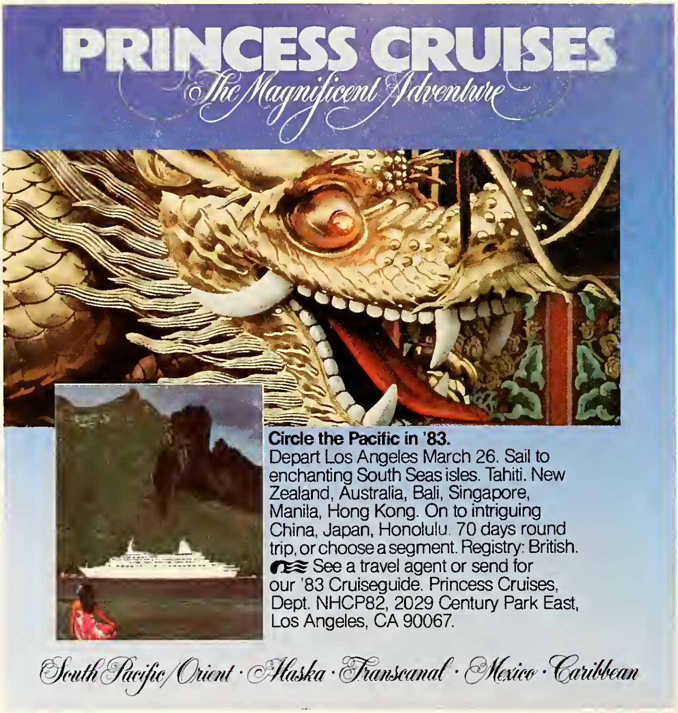
Very small numbers can be expressed exponentially, just as very large numbers can. Thus $1/100$ can be written $1/10^2$; and $1/1{,}000{,}000$, (a millionth) can be written $1/10^6$, and so on. It would be convenient if we could avoid the fractional form and, oddly enough, we can. Thus, 10,000 divided by 10 equals 1,000, which divided by 10 equals 100, which divided by 10 equals 10. In other words 10^4 divided by 10 equals 10^3, which divided by 10 equals 10^2, which divided by 10 equals 10^1. Each time an exponential ten is divided by ten, the size of the exponent is decreased by one.

Accordingly, 10^0 divided by ten is equal to 10^{-1}, which divided by ten is equal to 10^{-2}, which divided by ten is equal to 10^{-3}, and so on, forever. Since 1 divided by ten is $1/10$, which divided by ten is $1/100$, which divided by ten is $1/1{,}000$, and so on, it follows that $10^{-1} = 1/10$; $10^{-2} = 1/100$; $10^{-3} = 1/1{,}000$, and so on, forever. We can also see that if a million is 10^6, then one-millionth is 10^{-6}; if a trillion is 10^{12}, then one-trillionth is 10^{-12}, and so on.

Suppose a number is expressed in decimal form. With ordinary exponents, the exponent (as already mentioned) is equal to the number of zeroes after the 1. With negative exponents, the exponent is equal to the number of zeroes before the 1, provided one zero comes before the decimal point. Thus, $10^1 = 10$, while $10^{-1} = 0.1$; $10^8 = 100{,}000{,}000$, while $10^{-8} = 0.00000001$, and so on. What about a number such as 0.0000638? That is equal to 6.38×0.00001 and it can be written as 6.38×10^{-5}.

And there you are. Inventing a convenient system of writing numbers doesn't change the essentials or the facts, but it makes both a great deal easier to handle. In truth, if we continued to use whole thickets of zeroes at every turn, scientists would find matters so tedious, and would be so easily lost, that they might (in all seriousness) find themselves unable to function.

Isaac Asimov is a well-known science and science fiction writer who has more than 250 books in print. Not so well known is that he has a Ph.D. from Columbia University and is a professor of biochemistry at Boston University's School of Medicine.



PRINCESS CRUISES
The Magnificent Adventure

Circle the Pacific in '83.
Depart Los Angeles March 26. Sail to enchanting South Seas isles. Tahiti. New Zealand, Australia, Bali, Singapore, Manila, Hong Kong. On to intriguing China, Japan, Honolulu. 70 days round trip, or choose a segment. Registry: British.
See a travel agent or send for our '83 Cruiseguide. Princess Cruises, Dept. NHCP82, 2029 Century Park East, Los Angeles, CA 90067.

South Pacific/Orient · Alaska · Transcanal · Mexico · Caribbean

Exact Same Clock Sells Elsewhere for $26.95

SALE! $9.77 EACH

Incredible 'Everywhere' ALARM CLOCK
8 GREAT FEATURES:
- Hours
- Minutes
- Seconds
- Day
- Date
- Alarm
- Snooze Alarm
- Light-up Display

PLUS Fold-Out Easel Back

Actual size — Just 2 9/16"!

Car Dash/Boat
Pocket/Handbag/Briefcase
Kitchen/Office/Workshop

Really amazing—Convenient, dependable, and accurate to within seconds per year! This LCD Quartz marvel will stick-up anywhere . . . stand on a desk or counter . . . and travel along with you in pocket or purse. Lots of great features: hours, minutes, seconds, day, date, alarm, snooze alarm, and light-up display. Plus, a handy easel back *and* a FREE WALL HOLDER for instant stick-up. Handsome, sturdy, super-compact . . . This very same clock sells in catalogs for $26.95! Now yours for just $9.77 each . . . *Great Gift Idea!*

FULLY GUARANTEED
The quartz-crystal mini alarm clock runs at exactly 32.768 cycles per second—We guarantee it to be *accurate within two minutes per year.* If not totally delighted, simply return for full refund (except shipping & handling). Our policy is to process all orders promptly. Credit card orders are processed upon credit approval. Delays notified promptly. Shipment guaranteed within 60 days. (Dealer inquires welcome.)

Old Village Shop, Hanover, PA 17331

SATISFACTION GUARANTEED — MAIL TODAY!
OLD VILLAGE SHOP, Dept. VZ-7942
340 Poplar St., Hanover, PA 17331
Yes! Please rush my LCD Mini Alarm Clock(s) (Z51320D) as indicated below, on Full MONEY BACK GUARANTEE.
☐ One Clock for $9.77 plus $1.50 shipping and handling
☐ Two Clocks for $18.77 plus $2.50 shipping and handling
Enclosed is $______ (PA res. add sales tax)
CHARGE IT: ☐ American Express ☐ Carte Blanche ☐ Diners Club ☐ VISA ☐ MasterCard
Acct. No. ______
Exp Date ______
NAME ______ (please print)
ADDRESS ______
CITY ______
STATE ______ ZIP ______
☐ Check here and send 50¢ for year's subscription to our full-color catalog of fine gifts (Z389965X).
© H.H.I. Inc. 1982

Free to Be Extinct

Like death and taxes, the final disappearance of every species is inevitable

by Stephen Jay Gould

Bill Lee, certainly the most colorful if not the most skillful of baseball pitchers, once argued that his declining effectiveness on the mound could be traced to the "designated hitter" rule. (This rule, for you nonadepts, allows a manager in the American League to designate a permanent pinch hitter for any player in the regular lineup. Since most pitchers are hopeless at hitting, the designated hitter almost always substitutes for the pitcher, and pitchers, therefore, no longer come to bat.) "Every species that's become extinct," Lee proclaimed, "has done so because of overspecialization."

In this statement, baseball's self-styled philosopher repeats what may be the most common misconception about the history of life—that extinction is the ultimate sign of failure. No stigma seems to be greater than irrevocable disappearance. Dinosaurs dominated the land for 100 million years, yet a species that measures its own life in but tens of thousands of years has branded dinosaurs as a symbol of failure. Two years ago, for example, the good folks at Audi claimed (in unsubtle comparison with their large competitors) that *Brontosaurus* was "arguably the worst designed creature of all time." "Evolution," they continued, "has a sure way of correcting faulty design"—extinction, of course. Paleontologists rose in protest and Audi backed down. "You can be sure we will treat the *Brontosaurus* with more respect in the future," they promised.

I believe that this equation of disappearance with incompetence reflects an outmoded approach based on the false metaphor of progress and on an overly grim view of natural selection as a persistent and endless life-or-death struggle among competitors—the military version of such Darwinian phrases as "survival of the fittest" and "the struggle for life." If life moves ever upward and onward by ruthless battle and elimination of losers, extinction must be the ultimate sign of inadequacy. But life is not a tale of progress; rather, it is a story of intricate branching and wandering, with momentary survivors adapting to changing local environments, not approaching cosmic or engineering perfection. And success in natural selection is less the result of murder and mayhem than of producing more surviving offspring.

The equation of extinction with inadequacy makes no sense in the long view of paleontology. Extinction is the ultimate fate of all lineages, yet it would be absurd to argue that all species are therefore badly designed or poorly adapted. Extinction is no shame. It is, in one sense, the enabling force of the biosphere. Since most species are extraordinarily resistant to major evolutionary change and since many habitats are fairly full of species, how could evolution proceed if extinction did not open space for novelty? Would I be writing, or you reading, if dinosaurs had survived and mammals remained, as they had for 100 million years, a minor group of small creatures living in the ecological nooks and crannies that dinosaurs didn't penetrate?

If most extinctions were the direct result of competition with superior species, or even if most represented an inflexible failure to meet the challenges of minor environmental change (as Bill Lee charged), then a stigma might be attached to disappearance. But many, if not most, extinctions are reactions to environmental challenges so severe and unpredictable that we have no right to expect a successful response and, therefore, no reason to "blame" a species for its disappearance. A freshwater fish might dart and swim so elegantly that an engineer would proclaim its anatomy optimal. But if the lakes and rivers dry up, what defense does it have? Will blue whales be any less exquisite in design if rapacious humanity does the last one in? Some insurance policies offer no protection against cataclysms so momentous and unexpected that legal language calls them "acts of God." Species often die for reasons equally beyond control or calculation.

I may make these statements baldly, but you have no reason to accept them unless I can back them up with evidence and numbers. For the past decade, a group of researchers centered in Chicago (but admitting some outsiders like myself to marginal membership) have been working to quantify patterns of diversity in the history of life. These studies have provided our most extensive and consistent data on extinction. The findings support my central contention that extinction is no disgrace, but usually an inevitable result of circumstances beyond reasonable response. A pair of papers published this year in *Science* (issues of March 12 and March 19) reach three conclusions central to this discussion.

1. *A quantification of mass extinction.*

We have known since the dawn of paleontology that extinctions are not spread evenly over time, but are concentrated in a few brief periods of markedly enhanced, often worldwide decimation—the so-called mass extinctions of the geological record. The boundaries of the geological time scale correspond with these epochs of extinction. (Each year, when my students

PRINT AT 7,8
LET A=(B+C)/(D-E)
PLOT 5X,5Y
NEXT J
REFERENCE LIBRARY
ZX81
ZX81 BASIC

Personal computer breakthrough! $99.95

Now, revolutionary technology brings you a personal computer for only $99.95 Try the Sinclair ZX81 in your home for 10 days at no risk.

Here's the personal computer you've been waiting for: The Sinclair ZX81. It's a complete, powerful computer that can be yours for the remarkably low price of only $99.95. And just so you can see for yourself what a breakthrough in personal computers the ZX81 really is, you can try it in your home for 10 days at no risk. Simply use the order form below. Or call toll free.

Unique design makes it affordable.

The ZX81 was designed by Sinclair Research, the largest manufacturer of personal computers in the world. It's based on a radical new design that cuts costs dramatically without cutting computer power. The unique Master Chip, for example, replaces as many as 18 chips used in other personal computers. And your own TV works as the video display.

It's a remarkably attractive combination of high performance and low price. In just a few months, over 200,000 ZX81s have been sold.

Discover what computers are all about.

You can use the ZX81 to perform some business functions, though it isn't a business computer. You can use it to develop and play games, though it isn't a razzle-dazzle games computer. The ZX81 is a **personal** computer. It's the perfect computer to use if you want to learn about computers.

With Sinclair's step-by-step instruction book, included with your ZX81, it's easy to understand BASIC programming. You'll learn how to use the ZX81 for record-keeping and planning, budgets and lists. You'll learn how its computer graphic features can be used to develop charts and games, and what a computer game is all about. You'll even discover how it can be used as an educational tool to teach your children math, spelling, and other school subjects. But most importantly, you — and your children — will use the ZX81 to discover the excitement of working with a real computer.

Everything you need for $99.95

When you order the ZX81, you get the computer itself, Sinclair's comprehensive programming manual, and everything you need to connect the ZX81 to your TV. (We also supply connectors so that you can use a standard cassette recorder if you want to store your programs and data permanently.)

Full service on your ZX81.

With the ZX81, you don't have to worry about repairs. If anything goes wrong within 90 days, you can return it to us and we'll fix it or replace it. FREE. And after 90 days, our repair service is still as close as your post office.

Is it for you?

If you're considering buying an expensive computer but don't know the difference between PRINT and RUN . . . If you've got children over 10 who are learning about computers in school . . . If you've got a computer at work and wonder what makes it tick . . . If you want to challenge yourself in a new and exciting way . . . Or if you're just plain curious about computers . . . then the ZX81 is the perfect personal computer for you.

You only keep it if you like it.

You can try the ZX81 in your home for 10 days with no obligation. If you're not completely satisfied, simply return it to us for a full refund.

To order . . .

Simply call toll free, or use the coupon below. Remember, there's no risk. The sooner you act, the sooner you can be using the Sinclair ZX81 breakthrough personal computer in your home.

Call toll free 800-543-3000:

Ask for operator #509. In Ohio call: 800-582-1364; in Canada call: 513-729-4300. Ask for operator #509. Have your MasterCard or VISA ready. Phones open 24 hours a day, 7 days a week. These numbers are for orders only.

If you just want information, please write: Sinclair Research Ltd., 2 Sinclair Plaza, Nashua, NH 03061.

To order call toll-free: 800-543-3000

AD CODE: 08NH

Sinclair Research Ltd., One Sinclair Plaza, Nashua, NH 03061.

Yes! I'd like to try the Sinclair ZX81 personal computer. I understand that if I'm not completely satisfied, I can return it in 10 days for a full refund.

	PRICE†	QTY.	AMOUNT
ZX81 personal computer	$99.95		
Add shipping	$4.95	——	$ 4.95
		TOTAL	

( ) Check or money order enclosed.

Name ____________________

Street ____________________

City ______________ State ________ Zip ________

Sinclair technology is also available in Timex/Sinclair computers under a license from Sinclair Research Ltd.

†U.S. Dollars

sinclair

Sinclair Research Ltd.,
One Sinclair Plaza, Nashua, NH 03061.

groan at my request, or rather demand, that they memorize the geological time scale, I reply that those funny names—Cambrian, Ordovician, Silurian—are not capricious instruments of torture, but records of the outstanding events of life's history.)

D. M. Raup and J. J. Sepkoski have gathered and summarized the data of geological longevity for all forms of marine life. Their plot of extinction rates (families of organisms disappearing per million years) versus geological time offers few surprises in general outline, but provides our best and most consistent account of the *quantities* involved. Four brief periods of mass extinction stand well above the ordinary, or "background," rate of normal times, and a fifth nearly reaches the level of these major episodes. Two events mark the well-known era boundaries: the great Permian extinction, which may have extirpated more than 90 percent of shallow-water marine species some 225 million years ago, and the Cretaceous debacle, which wiped out remaining dinosaurs and a host of marine creatures some 65 million years ago. The three other events, although well enough known to paleontologists, are not emblazoned upon popular consciousness. Two occurred before the Permian (Ordovician and Devonian) and one between the Permian and Cretaceous (Triassic).

Raup and Sepkoski discovered that these brief mass extinctions are even more pronounced than previous data had suggested. The average background rate varies between 2.0 and 4.6 families per million years, while mass extinctions reach 19.3 families per million years. The authors conclude: "Our analysis shows that major mass extinctions are far more distinct from background extinction than has been indicated by previous analyses of other data sets."

Proposals for causes of these mass extinctions, as discussed in previous columns, range from continental coalescence and its sequelae (for the Permian) to asteroidal impact (for the Cretaceous)—causes that lie in the category of fluctuations beyond control or reasonable response and thus surrounding their victims with no aura of shame. Since these mass extinctions are even more massive than previously recognized, the scope of "blameless" extinction has been greatly widened.

2. *The supposedly classic case of extinction due to competitive inferiority cannot be supported.*

During most of Tertiary time (the "age of mammals") South America was an island continent—a sort of super Australia—with an indigenous fauna more than matching the marsupials down under for interest and peculiarity. The Australian region sports only one exclusive order of mammals, the egg-laying monotremes (echidna and duck-billed platypus). South America once housed several, with odd animals ranging from the rhinolike, but not rhino-related, toxodonts that Darwin discovered during his apprenticeship on the *Beagle*, to litopterns, which outhorsed horses by reducing toes from several to one and even losing the side splints (reduced vestiges of toes) that horses retain, to giant sloths and glyptodonts. Other oddities belonged to orders dwelling elsewhere but expressing a unique South American twist. The large mammalian carnivores, for example, were marsupials and included such outstanding creatures as the saber-toothed *Thylacosmilus*.

All these animals are gone today, victims of the greatest biological tragedy of the past 5 million years. For once, humans are absolved, and we must cite instead the rise of the Isthmus of Panama just a few million years ago. The isthmus connected South America with the more cosmopolitan fauna of northern continents. North American mammals came (wandering over the isthmus) and, in the traditional view, saw and conquered as well. What we usually regard as the modern "native" South American fauna—from llamas to alpacas to jaguars to tapirs to peccaries—are all relatively recent northern migrants.

The traditional view, with its odor of racist metaphor, pits a sleek, fine-tuned, and rigorously adapted northern fauna, tested in the crucible of harsh climates and relentless competition from previous waves of Asiatic and European migrants, against a lazy, stagnant, and untested native South American fauna. What chance did the poor toxodonts and litopterns have? Superior northern forms came streaming over the isthmus and wiped them out. In return, only a few inferior South American forms managed to travel the other way and survive. We got porcupines, opossums, and the nine-banded armadillo. South America received an entire new regime.

If this tale be true, then perhaps battle is the law of life and extinction does connote defeat. But is it correct? Do the numbers support it? Did more northern forms go south than vice versa? Were extinction rates much higher for South American forms? L. G. Marshall and S. D. Webb joined Raup and Sepkoski in a second article that applies the same quantitative methods to the recent faunal history of South America. They conclude that several aspects of the traditional story are not true.

The interchange was surprisingly symmetrical. Members of fourteen North American families now reside in South America, representing 40 percent of South American familial diversity. Twelve South American families now live in North America, forming 36 percent of North American families. In the Linnaean hierarchy, families represent a level just above genera and include such familiar groups as the Canidae (all dogs, wolves, and so on), the Felidae (all cats, including lions and tigers), and the Pongidae (all great apes). At the finer scale of genera, reduction was also balanced on both sides of the isthmus. Native South American genera declined by 13 percent between pre- and post-isthmian faunas. Native North American genera declined by 11 percent during the same interval. Thus, about the same number of families moved successfully in both directions and about the same percentage of native forms became extinct on both sides following the initial interchange. Why then does the record carry its apparent message of North American victory and South American carnage?

I believe that three major reasons account for this impression, one social, one biological but largely spurious, and the third real and important. We must consider, first, the chauvinism of most Anglophones in the United States (whoops, I almost wrote Americans). Anything south of the Rio Grande is Spanish speaking and therefore culturally linked with South America. But a good part of North America lies between El Paso and Panama, and most South American migrants live there, not in the United States or Canada. After all, the equator runs through Quito (in a nation appropriately called Ecuador), and South America contains more tropical land than North America. Therefore, most migrating South American forms are tropical or subtropical in their preferences, and their natural homes up north lie in Mexico or Central America. The paucity of South American migrants in my backyard (although I have seen an opossum) is no argument against their abundance or vigor.

Secondly, the taxonomic structure of South American forms dictated a greater effect upon overall diversity of design for an equal reduction in percentage of genera. When the isthmus rose, many of South America's indigenous groups had already been reduced to such a low diversity that the removal of a genus or two extinguished the entire group. Few North American groups were tottering so near the brink. If one fauna has twenty groups with one genus each, and a second has two groups each with ten genera, then a removal of four genera from each fauna will wipe out four of the larger groups in one fauna and none in the other.

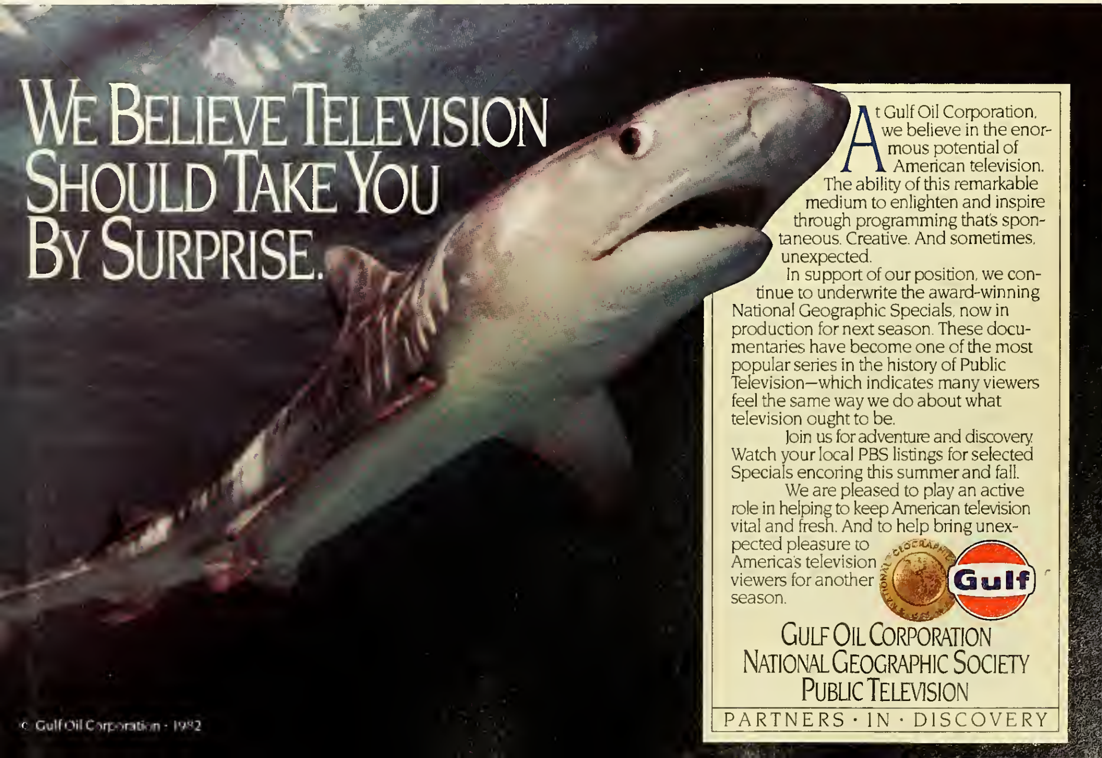
Finally, even though migrants moved with equal success in both directions and native forms declined in equal measure, North American migrants did fare "better" in one different and interesting way. When we count genera derived from migrants after they arrived in their new homes, we find an outstanding difference. In North America, genera originally from South America evolved very few new genera, while North American genera were remarkably prolific in South America. Twelve primary migrants from South America evolved but three secondary genera, while twenty-one North American migrants gave rise to forty-nine secondary genera in South America. Thus, North American forms radiated vigorously in South America and filled the continent with its modern fauna, while South American forms succeeded well enough in North America but did not radiate extensively.

Why this difference? The four authors suggest that a major phase in the rise of the Andes created a rain shadow over most of South America and led to the replacement of predominantly savanna-woodland habitats by drier forests and pampas and by deserts and semideserts in some areas. Perhaps North American forms radiated in a new habitat suited to their previous life styles, while South American forms continued to decline as their favored habitats shrank? Or perhaps the conventional explanation is true in part, and North American forms radiated because they are, in some unexplained way, competitively superior to South American natives—although most versions of "competitive superiority" will not explain higher rates of speciation but only success in battle (leading to longer duration of migrants coupled with higher rates of extinction among the vanquished, neither a component of this tale). In any case, the old story of "hail the conquering hero comes"—waves of differential migration and subsequent carnage—can no longer be maintained.

3. *A ray of comfort for the meliorists.*

The great eighteenth-century French naturalist George Buffon once expressed the fact of extinction in a fine literary image: "They must die out because time fights against them." We may now say, with equal literary license, that organisms may be fighting back. When Raup and Sepkoski compiled their data on the quantitative effect of mass extinctions, they made an interesting and unexpected discovery about the "background" level of normal times. They found that the background level has been slowly but steadily decreasing for more than a half billion years. In early Cambrian times, at the beginning of our adequate fossil record some 600 million years ago, the average rate stood at 4.6 families extinct per million years. Since then, the rate has declined steadily to about 2.0 families per million years. If the Cambrian rate had been maintained, 710 more family extinctions would have occurred that did not. It is intriguing—although I don't know what it means—that the total number of marine families has increased by almost the same number (680 families) since the Cambrian.

We must beware of reading too much into this arresting conclusion since, as Raup and Sepkoski remind us, biases of the fossil record must always be suspected as an artificial cause of such patterns. For example, probability of preservation increases for fossils in progressively younger rocks (greater extent, less opportunity for destruction of fossils by subsequent heat and pressure). Perhaps older families seem to live for shorter times simply because records of their early or late appearance are not preserved. But if this pattern


WE BELIEVE TELEVISION SHOULD TAKE YOU BY SURPRISE.

At Gulf Oil Corporation, we believe in the enormous potential of American television. The ability of this remarkable medium to enlighten and inspire through programming thats spontaneous. Creative. And sometimes, unexpected.

In support of our position, we continue to underwrite the award-winning National Geographic Specials, now in production for next season. These documentaries have become one of the most popular series in the history of Public Television—which indicates many viewers feel the same way we do about what television ought to be.

Join us for adventure and discovery. Watch your local PBS listings for selected Specials encoring this summer and fall.

We are pleased to play an active role in helping to keep American television vital and fresh. And to help bring unexpected pleasure to America's television viewers for another season.

GULF OIL CORPORATION
NATIONAL GEOGRAPHIC SOCIETY
PUBLIC TELEVISION

PARTNERS · IN · DISCOVERY

© Gulf Oil Corporation · 1982

does reflect a biological reality, then it suggests that modern families are more resistant to extinction and that the total rise in life's diversity may be a result of this increasing general hardiness.

Still, heroic though the fight may be (in inappropriate metaphor), organisms cannot win. The rate of familial extinction may have been cut in half during life's recorded history, but no species is immortal, and all must ultimately perish. The perfection of immediate adaptation is no protection against massive fluctuations of environment that inevitably, in the course of millions of years, affect every corner of the globe. Since Darwinian processes can only improve local adaptations, and since species cannot reckon the future (with one interesting and imperfect exception), all will eventually perish, leaving as potential patrimony only the altered descendants that may branch off from them.

I was in York Cathedral this spring, where I found the essence of this theme expressed in charming doggerel on the seventeenth-century tomb of one William Gee. Sir William, it seems, lived such a blameless life that if God wished to confer immortality upon anyone, His candidate had surely come forth. But Sir William died, so God must not entertain such an option:

If universal learning, language, law
Pure piety, religion's reverend awe,
Fair friends, fair issue: if a virtuous wife,
A quiet conscience, a contented life,
The clergy's prayers or the poor man's tears
Could have lent length to man's determined years.
Sure as the fate, which for our fault we fear,
Proud death had ne'er advanced this trophy here.
In it behold they doom, they tomb provide.
Sir William Gee had all these pleas, yet died.

(I have modernized spelling and punctuation, but not words or grammar. In line 8, read "would have" for the old subjunctive "had." Sir William's "issue" are his kids, so perhaps the family line survives.)

Inevitabilities should never be depressing. An old philosophical tradition, dating at least to Spinoza, proclaims that freedom is the recognition of necessity. If we respect intellect, true freedom must come from learning the ways of the world—what can be changed and what cannot—and by shaping a gutsy life accordingly. Besides, if species lived forever, we would have no science of paleontology, and I might have become a fireman after all.

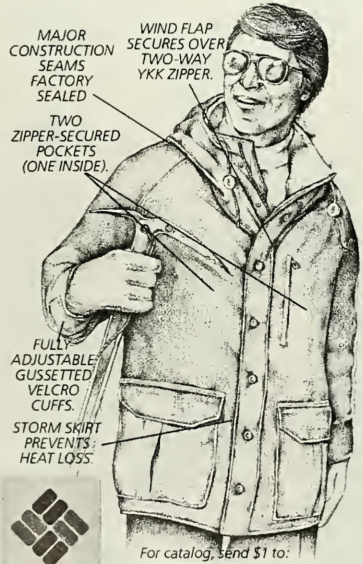
Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

Where in the world can you save money on a tropical vacation?

Now a vacation in peaceful Costa Rica is a better value because your dollar exchanges for twice as much as last year. Get away to our unspoiled beauty and year-round spring climate without blowing a bundle. For information write the Costa Rica Tourist Board, 200 S.E. First St., Miami, FL or call 800-327-7700, (800-432-7502 in FL), the airline that's happy to please you...LACSA.

LACSA
The Airline of Costa Rica

COSTA RICA
we have so much to share



MAJOR CONSTRUCTION SEAMS FACTORY SEALED
WIND FLAP SECURES OVER TWO-WAY YKK ZIPPER.
TWO ZIPPER-SECURED POCKETS (ONE INSIDE).
FULLY ADJUSTABLE GUSSETTED VELCRO CUFFS.
STORM SKIRT PREVENTS HEAT LOSS.

Item: The Trinity Alps

DESCRIPTION: Gore-Tex™ Thinsulate® Foul-Weather Parka.

SPECS:

Fabric: Gore-Tex™ laminated to Exacta™ Cloth.
Inside: Gore-Tex™ lets perspiration escape, but completely blocks rain, mist, etc.
Outside: Durable, snag-proof Exacta™ Cloth for long wear.
Insulation: Thinsulate® (200 gms./sq. meter). Extends to full length and hood. Factory-sealed major construction seams eliminate leakage.
Lining: Nylon taffeta.
Pockets: Total—6, 2 zipper-secured upper pockets, 2 Velcro-secured lower cargo pockets with "bellows" pleats for extra capacity, and 2 hidden Thinsulate® lined hand-warming pockets.
Hood: Permanent full cut for wear over headgear or alone. Drawstring provides weather seal. Soft visor shields glasses/goggles from rain.
Gen. Notes: Men's S to XXL. Women's XS to L. Made in Portland, Oregon.

For catalog, send $1 to:
Columbia Sportswear,
6600 North Baltimore,
Portland, Oregon 97203

Columbia Sportswear Company Portland, Oregon

Thinsulate ZEPEL GORE-TEX FABRIC

We don't just design it. We engineer it.

Thinsulate® is a registered trademark of 3M. Gore-Tex™ is a trademark of S. L. Gore & Assoc., Inc.

NE

"The Rattlesnake"

by Frederic Remington

- Available in a single limited edition issue of 9500 serially numbered sculptures.
- An outstanding museum quality reproduction in the great tradition of Frederic Remington.

Shown smaller than actual size of 8½" high.

One of Frederic Remington's best known and dramatic works — "The Rattlesnake" depicts in vivid detail the classic moment as horse and rider encounter a startled snake, while on the trail. The few original bronzes, made by Remington in 1905, are rare and have sold at auction for over $135,000. Now this ⅓ size reproduction is available for the unusual offering price of only $195.00 per sculpture.

The fine reproduction was produced under the direct supervision of Ms. Christine Roussel — former Director of the Reproduction Studio of the Metropolitan Museum of Art and creator of fine Remington reproductions for The Nelson Rockefeller Collection.

Each Rattlesnake replica will be created in cold-cast bronze — a medium that enables the casting of finer detail than the traditional hot-cast method. Every sculpture will be individually cast from a blend of powdered bronze and resins. Once the casting is completed, it will be finished with a rich patina, similar to the original. Each Remington Rattlesnake will be serially numbered and hallmarked. The edition will be limited to 9500 pieces and after that, all molds will be destroyed forever.

To reserve this important Remington reproduction, simply return the application. No payment need accompany your order at this time.

"The Rattlesnake"

Limit: one per person

New England Collectors Society, Dept. FR-2
62 Eastview Ave.
Pleasantville, N.Y. 10570

Please accept my reservation for "The Rattlesnake", to be crafted for me in cold-cast bronze at $195.00* plus $3.00 for shipping and handling.

I understand I need send no money now. When my sculpture is ready for shipment, I will be billed for my deposit of $49.50* and, after shipment, for the balance in three monthly installments of $49.50* each.

I would like my four equal payments of $49.50* charged to my:
☐ Master Card ☐ VISA

Or call Toll Free: 1-800-228-2028 ext. 560

Credit Card # ______

Exp. Date ______

Signature ______

all applications are subject to acceptance

Name ______

Address ______

City ______

State ______ Zip ______

*N.Y. residents add 5% for sales tax.

The Great Amateur of Archeology

John Aubrey studied ancient British monuments in an age that had little notion of the prehistorical

by John Fowles

To net John Aubrey in a brief essay is no easy task. How does one describe a genius who never completed anything? Who left not only all his work but all his posterity in enduring confusion? Who constantly apologized for his lack of literary skill, yet whom we now see as one of the most attractively natural prose writers of his age? Who was hopelessly improvident in all personal matters, yet a brilliantly intuitive hoarder of otherwise lost facts, an enduring gold mine for all students of seventeenth-century life? Who never managed to command even one science well, yet whose place in the history of science is assured? Who did more than anyone to point the way toward modern archeology, yet until very recently was generally regarded as little better than an amusing minor tattler?

Generations of scholars, as they have stumbled and groped their way through the three decades of notes, erasures, incomprehensible cross-references, repetitions, classical quotations, insertions in other hands, blanks where Aubrey's memory failed him, illegible additions, and all the rest of it, have cursed the wild undergrowth of the *Monumenta Britannica* manuscript, Aubrey's survey of Britain's ancient archeological sites. Yet I doubt if we shall ever have a more revealing view from the inside of what it was like to be finding one's way, though often down cul-de-sacs and wrong turnings, toward a new vision of the past and a new scientific discipline of the future. It can be seen as a voyage through an ancestral Anglo-Saxon mind, as revealing and remarkable in its individual way as that other coming-to-terms with a both ancient and new world that was going on across the seventeenth-century Atlantic.

John Aubrey was born on 12 March 1626 ("about sun-rising, being very weak and like to die"—he was to worry about his health all his life) at Easton Piercy, near Malmesbury in Wiltshire. His parents belonged to the minor, but ancient, gentry, with many connections by marriage and remote cousinry—"cousin" in this text is not to be taken in strict modern terms—in the West Country and Wales. There were some modestly distinguished forebears, the most famous being Dr. William Aubrey, a favorite lawyer of Queen Elizabeth's. These relations reached "down" to John Whitson, a merchant lord mayor of Bristol (also at one time the owner of the *Mayflower*), and "up" to aristocrats such as the earl of Abingdon. The one financial good fortune Aubrey had, during an otherwise conspicuously luckless life in that way, was his unquestioned rank of gentleman. This was to serve him in good stead when he was near penniless in later life. A lonely, sensitive, and morbid child, "bred up in a kind of park, far from neighbors and no child to converse with" (his next two brothers and a sister all died in infancy, and his other two brothers were not born till 1643 and 1645), he seems to have been a fair scholar, and his love of the past declared itself very early. Even at the tender age of eight, he was later to recall, he grieved at the then common custom of binding schoolbooks with ancient parchment documents.

This was to be a marked, if not the dominant, feature of his life. He is one of the first clear and declared conservationists—as opposed to mere collectors—in modern history. Even his own collecting was essentially conservationist and public spirited. It was not for nothing that he was inscribed among the founding donors of the famous Oxford museum that still bears his friend Elias Ashmole's name, while laments for lost or vandalized material recur again and again in all his work.

He was still at a village school when he came under another enduring influence, that of the philosopher Thomas Hobbes (1588–1679), a celebrated former pupil of Aubrey's schoolmaster. Hobbes was to become a friend in later years, and Aubrey wrote an invaluable life of him. From Leigh Delamere he went to a famous school at Blandford Forum in Dorset. He wrote a little report on himself at the end of those years.

> Mild of spirit; mightily susceptible of fascination. My idea very clear; fancy like a mirror, pure crystal water which the least wind does disorder and unsmooth. Never riotous or prodigal; but . . . sloth and carelessness are equivalent to all other vices.

From Blandford he went to Oxford, at the age of sixteen, in 1642. But he never completed his studies because of the disruptions of the civil war that began that year, nor did he complete those at the Middle Temple in London, where he went in 1646 to study law. But he had by this time graduated in a subject and faculty for which universities have never managed to find a place and in many cases (still today, alas) seem especially designed to suppress: universal curiosity. Even as a young undergraduate of eighteen Aubrey had made drawings of Osney Abbey near Oxford, knowing it was soon to be destroyed. Bohemian etcher Wenzel Hollar's later engraving of one of these drawings is now our only visual record of the lost building.

It is a little as if he realized he could never rival his more orthodox contemporaries in any one field and therefore instituted himself magpie, with privilege to raid from all of them. All his life he was to

---

Introduction by John Fowles to *Monumenta Britannica*. Reprinted by permission of Little, Brown and Co., © 1980 Dorset Publishing Company.

Fill out this coupon and save the children

Complete this simple questionnaire, and befriend a needy child through Save the Children. For only fifty-two cents a day, your money, combined with that of other sponsors, can breathe new life into an impoverished village . . . help hardworking people in their fight for dignity . . . turn despair into hope for a child who has known only disaster. Fifty-two cents may not buy much where you live. But for the poorest of the poor where the need is so desperate, it can work miracles.

NH 8/2

My Name Is ______________________________
(please print)

Address ______________________________

City ________________ State ________________ Zip ________________

Tell us how you want to help, by answering these questions:

1. What kind of child would you like to help?

☐ Boy ☐ Girl ☐ No preference

2. What geographical area are you interested in?

Urgent need exists in all the areas listed below, especially overseas. If you have a strong preference for a particular location, check the area of your choice. If not, won't you please let us assign a child where the need is greatest?

☐ **Certainly. Choose a child for me in an area of greatest need.**

I strongly prefer:

☐ Africa
☐ American Indian
☐ Appalachia
☐ Bangladesh
☐ Chicano (U.S.)
☐ Colombia
☐ Dominican Republic
☐ Honduras
☐ Indonesia
☐ Inner Cities (U.S.)
☐ Israel
☐ Lebanon
☐ Mediterranean
☐ Mexico
☐ Nepal
☐ Southern States (U.S.)
☐ Sri Lanka (Ceylon)

3. Would you like a picture of your sponsored child?

Shortly after we select a child for you, we can send you a photograph and brief personal history, if you desire.

☐ Yes ☐ No

4. Would you like to exchange correspondence?

If desired, correspondence can build a meaningful one-to-one relationship and provide a unique educational experience for the sponsored child. In areas where illiteracy is high, a village representative will keep you informed of the progress your child is making. Translations, where necessary, are supplied by Save the Children.

☐ Yes ☐ No

5. Would you like information about the child's community?

When you become a sponsor, your funds are used to help children in the most effective way possible—by helping the entire community with projects and services. For health care, education, food production, and nutrition. Several times a year you can receive detailed reports on these community activities which provide permanent improvements to the child's environment. Would you like to receive such information?

☐ Yes ☐ No

6. How do you wish to send your sponsorship contribution?

Enclosed is my check for $________.

☐ Monthly, $16 ☐ Semi-annually, $96
☐ Quarterly, $48 ☐ Annually, $192

7. Do you wish verification of Save the Children credentials?

Save the Children is indeed proud of the handling of its funds. Based on last year's audit, an exceptionally large percentage (83.3%) of each dollar spent was used for program services and direct aid to children and their communities. Due to volunteered labor and materials, your donation provides your sponsored child with benefits worth many times your total gift. Would you like to receive an informative Annual Report (including a summary financial statement)?

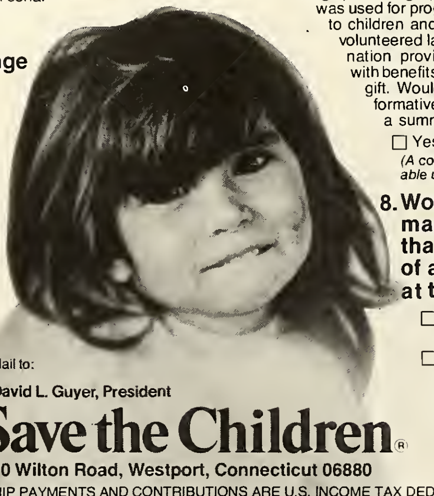
☐ Yes ☐ No

(A complete audit statement is available upon request.)

8. Would you rather make a contribution than become a sponsor of an individual child at this time?

☐ Yes, enclosed is my contribution of $________.

☐ Check here for general information about our unique programs for aiding impoverished children.



HELPING CHILDREN 50 years 1932 • 1982

Mail to:

David L. Guyer, President

Save the Children®

50 Wilton Road, Westport, Connecticut 06880

YOUR SPONSORSHIP PAYMENTS AND CONTRIBUTIONS ARE U.S. INCOME TAX DEDUCTIBLE

The original U.S. child sponsorship agency. Member of American and International Councils of Voluntary Agencies.

© 1981 SAVE THE CHILDREN FEDERATION, INC

remain diffident and humble before what he saw as real scholarship. Though the eventual value of this go-between role was seen by the huge network of learned friends and acquaintances it accumulated, Aubrey was unfortunately often relegated by it to becoming a kind of research assistant, what we might think of as "a useful contact." Few of the men who used him can have appreciated his real originality, precisely because it was so unorthodox. They may also have been blinded by something more personal, his very unscientific genius for friendship. He was indisputably one of the nicest and most amicable human beings of his century.

Aubrey had not been left a pauper when his father died in 1652. But in the course of the next two decades he somehow managed—partly as a result of his own fecklessness, partly because of a long-drawn-out and bitter lawsuit with Joan Sumner, a woman he had offered to marry, to say nothing of further differences with his own "tiger" of a younger brother (who even menaced Aubrey with prison at one stage) over their joint inheritance—to end up a near-bankrupt and more than once on the run from "crocodiles," or bailiffs. From the 1670s on, his life was to be perpetually under an evil star. Aubrey believed very literally in the evil star since like many (including some far finer scientific minds) of his time he had a firm faith in astrology.

He fell back on the traditional seventeenth-century insurance against penury, if one had birth and brains, and for much of the rest of his life, he lived by what might appear to us as sponging on friends. But this would be to misunderstand polite society then. Such hospitality, or tacit patronage, was regarded as a duty by the rich and well landed largely because it was also a source of pleasure—a means of entertainment, of keeping in touch. A closer parallel might be with the medieval traveling minstrel, even if the notion of singing for one's supper is not appropriate. One noble friend, Lord Thanet, did once (unintentionally) imply the relationship was salaried, between master and servant. The armigerous gentleman in Aubrey was evidently deeply offended, for immediate and complete apology was made. His appearance at one's door must have been like the arrival of some human intellectual magazine, plus lively gossip column, hot from the coffeehouses of London and Oxford. But then he loved books, music, painting; wit and women; he was never a grave doctor.

Aubrey began his habit of jotting down "philosophical and antiquarian remarks" in notebooks in 1654. Neither adjective, of course, means quite what it does today. The first covered anything to do with human knowledge; the second, anything to do with the past—from Aubrey's own boyhood memories to remotest antiquity, the domain we now call archeology. We must always remember this before we start complaining about the lack of order, the mishmash of subjects, the way Aubrey will jump without warning between fields that are for us totally distinct and without modern scientific connection at all. His view is holistic; he thinks far less of different subjects, all neatly frontiered and separated, than of different angles of approach to the central problem: What was the past? What was it like?

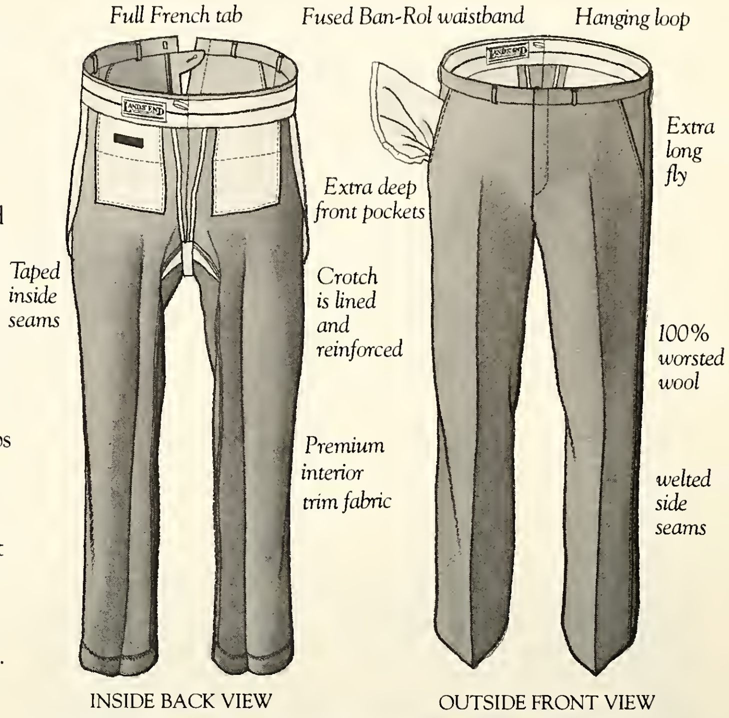
His truly archeological (before the term) side was given a sharp new spur by the publication in 1655 of the very first book to be entirely devoted to England's most famous ancient monument, Inigo Jones's *Stonehenge Restored*, "which I read with great delight." Part of the delight was of a kind agelessly familiar to scholars, that of shooting down someone else's theory. Aubrey, who knew Stonehenge (not far from his birthplace), saw at once that Jones and his son-in-law editor, John Webb, had allowed preconceived theory (that Stonehenge must be Roman) to override the evidence on the ground. "This gave me an edge to make more researches," he says. One of the results of these was the discovery of the famous ring of holes, just inside the surrounding ditch, that now bears his name—and whose exact function remains a major bone of contention between contemporary archeologists and astronomers. Of equal importance with this first empirical approach to the enigmas of Stonehenge was a discovery Aubrey had made even earlier: of the great "sister-monument" of Avebury, a few miles north across Salisbury Plain. He first saw this in January 1649, in his twenty-second year. Of course, it had been there for anyone to see for 4,000 years or more, but it had to wait until John Aubrey came, to be recognized for what it was, a document—though wordless—as vital for British prehistory as Stonehenge itself.

It is typical of the man, of his focal, one might almost say public relations, role that by 1663 he had lured King Charles II and his brother, the future James II, to visit the site under his guidance. They had first heard of it by a characteristically striking simile Aubrey had invented, to the effect that Stonehenge could no more be compared with Avebury than a church with a cathedral, and pricked up their royal ears. The visit made, their command was that he should write upon the subject, and this was the origin of *Monumenta Britannica*.

It was not the origin of his desire to be published. Seven years earlier, in 1656, he had decided to embark upon *The Natural History of Wiltshire*. The spur here had been provided by the immensely learned antiquarian Sir William Dugdale, whose *Monasticon Anglicon* (1655) and *Antiquities of Warwickshire* (1656) were universally admired and set new standards in historical erudition. This first literary essay was not to be published until long after Aubrey's death, but already his originality is apparent. There is the unusual feel of someone who works on the ground quite as much as from documents in a study or library. Its attempted comprehensiveness is equally striking. Quite apart from natural history proper, it covers a huge range of subjects, from a history of local cloth manufacturing and of fairs and markets to witchcraft and phantoms. One chapter heading is "Men and Women." In other words, the book stretches from geology through local history to anthropology and folklore. It was the latter material that shocked so many earlier students of Aubrey, the plunges into (by eighteenth-century rationalistic and nineteenth-century scientific standards) superstitition and blind credulity. We are wiser now and can see that whether Aubrey himself believed in these things is far less important than that they were recorded for posterity.

We must be very careful over the word *superstition*, or what it really meant to Aubrey. He could never resist recording supernatural occurrences, inexplicable events, but the great bulk of this material concerns what a modern social historian would regard as folk tradition and folk custom. Aubrey was always intensely conscious, having lived through it, of the appalling blow the Puritan revolution ("modern zeal" as he sarcastically baptized it) had dealt this side of English life—as viciously doctrinaire an iconoclasm as the endless window smashing and image defacing that had gone on in the churches. He was determined to save what he could, and we must see this as an aspect of his conservationism—and a far more original side of it than the one concerned with old documents and Roman remains and the rest. In his concern for the latter, he is not alone in his age—it was already museum-minded. In giving a same concern for folklore and oral tradition, he is unique, far more of our century than his own. When he wrote that "wars do not only extinguish religion and laws, but superstition," he is talking far less about ghosts and weird prodigies than about the

We turned a lot of pants inside out before specifying the trousers in the Lands' End Charter Collection


Full French tab
Fused Ban-Rol waistband
Hanging loop
Extra long fly
Extra deep front pockets
Taped inside seams
Crotch is lined and reinforced
100% worsted wool
Premium interior trim fabric
welted side seams
INSIDE BACK VIEW
OUTSIDE FRONT VIEW

Before electing to get into traditional clothing, we asked ourselves some hard questions, the kind you owe it to yourself to ask, next time you shop for a pair of slacks...

What should a really good trouser have? How should it be made?

Our findings and what we did about them.

- ☐ We found most front pockets are too shallow at 12 inches. (Ours are now 13.)
- ☐ Most watch pockets with flaps are too bulky. (Lands' End watch pockets have no flaps.)
- ☐ A quality pocket fabric prolongs trouser life. (We don't cut corners here.)
- ☐ Trousers tend to sag in the center of the back. (We've added an extra center belt loop. Plus a "locker loop" for noontime racquetball players.)
- ☐ Expensive pants shouldn't have ragged interior seams. (We tape ours, and reinforce the crotch seam while we're at it.)
- ☐ A curled waistband looks sloppy. (Ours has Ban-Rol and, because neatness counts, our trousers have ¼-inch welted side seams.)

A kind of breakthrough.

None of the above items in itself is a major improvement, but to put them all into one pair of pants is some sort of breakthrough—even if we priced them at $70 to $80.

Yet these features are yours in the Lands' End Charter Collection priced from $39.50 to $49.50. If you take the time to comparison shop, you'll find that's a little astonishing.

Not one fabric, but five.

We offer four 100% worsted wool fabrics—flannel, covert twill, gabardine and tartan plaid. Plus: a 65/35 tropical worsted.

As always, our objective has been a simple one. To be sure we're offering *quality,* at a reasonable *price,* that we can support with proper *service.* Backed by an unconditional *guarantee.*

Try us. Send for a catalog. Better still, call our 24-hour toll-free number: 800-356-4444.

You'll find that, along with our trousers, we'll turn ourselves inside out to serve you.

LANDS' END
DIRECT MERCHANTS
of fine wool and cotton sweaters, Oxford button-down shirts, traditional dress clothing, snow wear, deck wear, original Lands' End soft luggage and a multitude of other quality goods from around the world.

☐ **Please send free96-page catalog.**
Lands' End Dept. P-10
Dodgeville, WI. 53533

Name__________
Address__________
City__________
State__________ Zip______

Or call Toll-free
800-356-4444
(Except Wisconsin, call 608-935-2788)

archeology of the rural mind: in his own phrase, "the ancient natural philosophy of the vulgar."

Certainly Aubrey seems to believe in superstitions, in recipes and spells, that we know are absurd. But in those days the "preternatural," as Aubrey calls it, was rather more than a matter of scientific reason against sheer unreason. Those who studied it were not always merely credulous. Their age had a desperate thirst for explanation of the ways of the world, both natural and human, and their manias for astrology, alchemy, mystic ciphers and the like were also a part of this. It may surprise (or horrify) us to think of Newton wasting so much time on decoding the Book of Revelation, of Kepler believing quite literally in a music of the spheres, but in another way they were allowing for every possibility, leaving no avenue unexplored. The area was also fraught with dangers of a quite practical kind. The Puritan spirit was very far from dead in Restoration England.

Many kinder friends, such as the naturalist John Ray, did feel Aubrey based himself too much on idle hearsay, and this is a justifiable complaint when he is dealing with natural phenomena or in the *Monumenta*. But in folklore (and anthropology) there is no idle hearsay; it is all evidence of some kind. The endless past scorn poured on this side of his work also overlooks the fact that more often than not he is either downright disbelieving or openly skeptical or simply recording what he has seen. He says of ghosts, "Where one is true, a hundred are figments. There is a lechery in lying." And here is Aubrey recording, as well as any modern anthropologist, at the end of his life:

> On the day of St. John the Baptist, 1694, I accidentally was walking in the pasture behind Montague House [where the British Museum now stands]. It was 12 o'clock. I saw there about two or three and twenty young women, most of them well habited, on their knees very busy, as if they had been weeding. I could not presently learn what the matter was. At last a young man told me that they were looking for a coal under the root of a plantain, to put under their head that night, and they should dream who should be their husbands. It was to be sought for that day and hour.

We know where this strange idea came from, a book published in 1613; without Aubrey, we would never have known it was practiced. (The girls were wrong, incidentally. It should be Saint John's Eve, not the day itself.)

"Fancy like a mirror" was to remain true of him all his life. He was an ideas

The Questers Program for Fall & Winter 1982

Stimulate your mind on a Questers nature tour.
We search out the plants and animals, birds and flowers...
and explore rain forests, mountains and tundra, seashores,
lakes and swamps. There is ample time to photograph, absorb, reflect.
Naturalist guides, small tour parties, first-class accommodations.

Worldwide Nature Tours Fall & Winter 1982 Departures

The Americas

Everglades: 11 days, Nov. 4, Apr. 7 • Hawaii: 15 days, Oct. 10, Dec. 19, Feb. 10, Mar. 24 • Southern Mexico: 14 days, Dec. 19, Feb. 13 • Panama & Costa Rica: 14 days, Dec. 18, Feb. 12 • The Amazon: 17 days, Oct. 10, Nov. 14, Jan. 9 • Ecuador and Galapagos: 15 days, Oct. 28, Dec 30, Feb. 10 • Peru: 17 days, Nov 6 • Patagonia & Tierra del Fuego: 21 days, Nov. 6, Jan. 10 • Trinidad & Tobago: 11 days, Nov. 8, Mar 7

Asia & Africa

The Himalayas: 23 days, Oct. 7, Mar. 17 • India: 23 days, Oct. 30, Jan. 29 • Sri Lanka: 18 days, Nov 19, Feb. 18 • Kenya: 23 days, Oct. 21, Feb. 3.

Australasia

Australia & New Zealand: 30 days, Oct. 2, Feb. 12 • New Zealand & Milford Track: 22 days, Nov. 12, Feb. 11.

New & Special Tours

We will also be offering in 1983 a number of new and special tours. Among them are.

- New Guinea
- Walking in the Foothills of the Western Himalayas
- Japan
- Madagascar/Réunion/Mauritius
- Okefenokee Swamp & Georgia's South Coast

Write or call today for your complimentary Directory of Worldwide Nature Tours and to be placed on our mailing list. If you are interested in a particular tour, please request its Detailed Itinerary.

QUESTERS
Questers Tours & Travel, Inc.
Dept. NH, 257 Park Avenue South
New York, NY 10010 • (212) 673-3120

DISCOVERY TOUR TO THE NILE

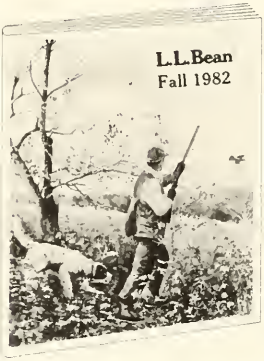
American Museum of Natural History
Discovery Tours

Discover the world of ancient and modern Egypt on an American Museum 600 mile Nile Cruise. Explore with three lecturers the rich natural and archeological sites of an area which has fascinated visitors for centuries... A carefully planned itinerary (with a special two-day program in London visiting the British Museum with its curator) provides a relaxing and thorough three-week Discovery Tour. All of the major Nile archeological sites as well as the important wildlife regions are discussed and visited with your balanced team of eminent lecturers. Share with Museum staff and friends an unforgettable cruise. February 6-26, 1983. For further information and itineraries write to the **American Museum of Natural History, Discovery Tours,** Central Park West at 79 St., NY NY 10024, or call (212) 873-1440.

man, a lateral thinker. Possibilities and hypotheses poured from him, even in matters as mundane—in a little work called *Faber Fortunae*, or "How to Make a Fortune"—as his own perennial lack of the ready. Many of his ideas and theories are farfetched or flagrantly based on too little evidence or on wrong deductions (not least with some of his archeological conclusions); but others show great predictive insight. Aubrey had at least one feature of scientific genius—a nose for what is missing. He wishes, in the *Natural History*, for a geological map "coloured according to the colours of the earth, with marks of the fossils and the minerals"—a desideratum that had to wait more than a century, and the pioneer geologist William Smith, to see fulfillment. He demanded a history of the weather and thus foretold the paleoclimatology of our own century. He thought the world "much older than is commonly supposed," on the hard evidence of the depth at which fossils had sometimes been found. He even touched Darwin with a finger tip, when he wrote that "fishes are of the elder house"; that is, have older origins than humans and mammals. His whole approach to history is markedly "evolutionary." Other writings of his concern histories of costume and of architecture—change of style through the ages. Nothing more commonplace, we may think. But no one before Aubrey had thought of studying clothes and buildings in this chronological way, or for that matter, had studied them in any way at all, except in the Greek and Roman context.

I must now turn to the *Monumenta Britannica*, otherwise *A Miscellany of British Antiquities*. It was designed to be in four parts (written in two notebooks, Bodleian Library T.G. c. 24 and 25). The fourth part is a medley of subjects, including the studies of costume and architecture mentioned above, and also one on paleography, remote from archeology proper.

The desirability of publishing the manuscript was recognized early. Even in the 1670s both Sir Thomas Browne and John Locke had urged Aubrey to get the *Templa Druidum* section into print. On 11 August 1690 the notebooks, by then of course much richer in content, were left with Robert Hooke. In 1692 they were tried on various London bookseller-publishers, without success. By 1693 Aubrey was hoping for publication by subscription at Oxford, where he had found a new, young (he was only twenty) scholar-friend, Thomas Tanner, later to be bishop of Saint Asaph. Tanner was sympathetic over the iniquity of such a valuable collection not being published, and Aubrey



L.L.Bean®
Outdoor Sporting Specialties

FREE Fall Catalog

Fully illustrated. Features quality apparel and footwear for men, women and children; camping, hunting, hiking and winter sports equipment.

For 70 years L. L. Bean has offered practical and functional merchandise at reasonable prices. Our clothing and footwear is rugged enough to withstand active outdoor use, yet attractively styled and comfortable for casual wear. Many items are of our own manufacture. All are guaranteed to be 100% satisfactory or your money back.

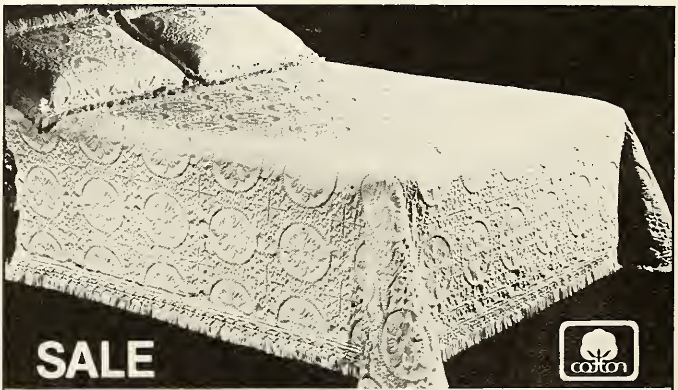
☐ **SEND FREE CATALOG**

Name____________________

Address____________________

City__________ State_____ Zip________

L. L. Bean, Inc., 741 Casco St., Freeport, ME 04033



Beautiful
Early American
"COLONIAL LOFT"
BEDSPREADS

- **Heavy—soft—durable**
- **100% Quality Cotton**
- **Machine washable**
- **Choose white or natural**
- **Special Prices:**

Twin 80 × 110, value $40...... only $32.95
Full 96 × 110, value $50....... only $39.95
Queen 102 × 120, value $65. only $47.95
King 120 × 120, value $75.... only $55.95
Sham (standard), value $15...only $11.95 ea
Add $2.50 per order for shipping

100% Natural Cotton, soft but ever so durable. A true legacy of Early America. This elegant woven bedspread is fully pre-shrunk and machine washable, with no ironing ever. Rich, full, all-cotton decorator fringe. **Guaranteed.** We ship fast.

Homespun Crafts • Dept. NH-5, Box 1776
Blacksburg, S.C. 29702

Gentlemen: Please rush ________ "Colonial Loft"
_____ Size spreads & _____ shams, color ________
☐ Check ☐ M.O. enclosed ☐ M.C. ☐ Visa
Credit Card No. __________ Exp. Dt. _____
Name ____________________
Address ____________________
City __________ State _____ Zip _____
M/C, VISA orders—call toll free 24 hours.: 800-438-7939, Ext. NH-5 or dial 800-458-3491, Ext. 88-A. CALL NOW!

seemingly placed great hopes on the young man as a supervising editor.

A *Proposal for Printing* was even issued, and 112 subscriptions were taken, but these were not sufficient to proceed. Aubrey's subscription fell in conflict with that for the new edition of Camden's *Britannia*, and was the loser. The *Proposal* said the *Monumenta* was "to be printed in folio with abundance of cuts [engravings]," total price eighteen shillings, nine on subscription, nine on delivery, which was promised before "Candlemas next," or February 1694. The blurb declares that ancient British history was drowned and perverted in the "deluge" of the Saxon invasion (Aubrey seems to have thought as little of the Saxons as he did of Puritans), which "I do here endeavour (for want of written record) to work out and restore after a kind of algebraical method, by comparing them that I have seen one with another and reducing them to a kind of equation: to (being but an ill orator myself) make the stones give evidence for themselves."

In other words, he means to proceed by comparing known to less known, and from field evidence, a very new approach to antiquities. In 1695, the Oxford venture having failed, Aubrey found an interested London bookseller, Awnsham Churchill, and even entered into an agreement with him. But Churchill never honored his side of it, and the notebooks were still with him at Aubrey's death. They eventually came into the hands of a descendant, Col. Sir William Greville, who in 1836 sold them to the Bodleian.

However, they had by no means been entirely lost to view before they finally returned to Oxford. Copies existed of parts of the manuscript. It had already been used by Gibson and Lhwyd in *Britannia*. Above all, it was seen by the next major British antiquarian William Stukeley, and gave him (though he never acknowledged it) the central idea of his life, for it is Stukeley who took Aubrey's quite cautiously stated belief that Avebury and Stonehenge were Druid temples and succeeded in converting it, during the first half of the eighteenth century, into the most notorious false trail in British archeology—one that was to mislead the science well into our own century, and has its benighted followers even today.

Aubrey had been quite sure the monuments predated the Romans and the Danes, in itself a step forward, but he lived at a time without any notion at all of the prehistorical—the existence of cultures not only without written record but also unreported on by any others that were literate. The only known culture before the Romans came was the one they subdued (and their historians reported), the Celtic, or British, and we can hardly blame Aubrey for suggesting it or its Druid priesthood as the most likely architects and builders.

On one simple but very important count the value of the *Monumenta* is unassailable and represents something for which we can only be grateful. Perhaps the most characteristic note in the entire work is scribbled as an afterthought above another entry. "Force in this here," writes Aubrey, "though it be foreign [misplaced] as to the county, to preserve it from being lost and forgotten." Not for the first time he found himself caught between method and instinct. His answer is always the same—when in doubt, include. The sorting and pigeonholing and censoring can come later. We see this deliciously in the draft of his life of Hobbes, who had an uncle who was a mere glover. Having mentioned that fact, Aubrey is assailed by doubt and adds a parenthesis to himself: "(Shall I express or conceal this *glover*?)" In archeology as in biography, the "glover" is always finally allowed to creep in. In this alone the *Monumenta* is beyond price. Countless of his sites no longer exist; many have changed beyond recognition. Some that have disappeared, future archeologists may one day rediscover from his clues. Nor does this take any account of the information left us on the early history of known sites—to say nothing of all we can gather of how his fellow antiquarians felt and thought, what they collected, and so on.

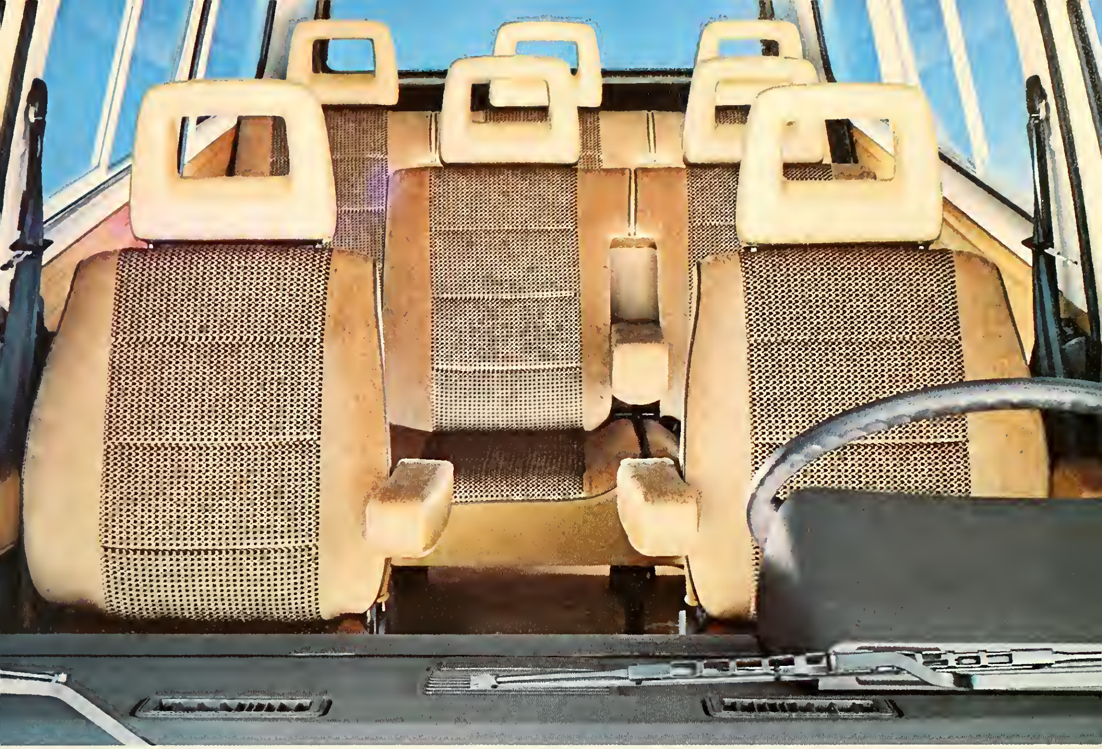
Aubrey's originality lies in the accent, one might almost say the flavor, he gave his work. In his stress on direct observation and field knowledge, as opposed to that from books and traditional authority; in the attention paid, for the first time, to whole new classes of monuments such as hill-forts and barrows—in effect to nonverbal evidence; in the attempt to reconstitute the past, to imagine it, to reconstruct its changes and cultural flow; in showing one must look "behind" the Romans, a brave leap of the imagination in a period deeply imbued with unquestioning respect for ancient Rome. It was, not things, but books and documents that dominated the writing of history in the seventeenth century. But even when Aubrey falls back on this usual method, he is often imaginative in his use of quotation. Long before Schliemann he took an archeological look at Homer. No one reading his Homeric extracts on Greek burial customs will forget the astonishing recent discoveries made in Macedonia.

It is this general spirit that surely matters most. Of course Aubrey suffered from countless misconceptions, and he still leaned far too much on secondhand evidence and tradition. He was undoubtedly split between the old and the new science of his age, perhaps partly because historiography then lagged behind the natural sciences. By the end of the century, enormous advances had been made in natural history by botanists such as Ray. It was not that this did not filter through to Aubrey, to whom natural history was always a major interest. Indeed, a leading authority on Aubrey, Michael Hunter, argues convincingly that it is Aubrey's view and philosophy of natural history that structures, and lends much of the originality, to his antiquarianism—that is, at his best, he is trying to do for the past what contemporary naturalists were doing in terms of ordering and refining the study of nature, and this is why he may be distinguished from more orthodox—and pedestrian—antiquarians.

He had many rivals far more learned in their fields than he ever became himself, in comparison with whom he can really only be called a dabbler or dilettante. Others, such as Sir Thomas Browne, wrote in a style equally beyond him. Very few can read *Urn-Burial* today for archeological reasons, but it will be read for its magnificent baroque cadences as long as the language survives. Nothing could have been further from the elaborate taste of the day than Aubrey's highly idiosyncratic, fastidious-careless style, as he well knew. It was much too near to spoken English, the tone of the private letter, as if he is always half talking to himself; not nearly artificial and Latinized enough for serious consideration. His modesty here is scarcely credible to us now, who see him as one of the supreme masters of unforced, naturally poetic English prose. He once wrote this: "I did see Mr. Christopher Love beheaded on Tower Hill in a delicate clear day." All his genius lies in that unexpected "delicate." I have long held it the most pleasing short sentence in the language.

In his time Aubrey could not pretend to vie with these dignified and sober professionals, the sort of men who would today occupy university chairs; yet somehow he slipped through. He is the great amateur of archeology, but in all senses of that word, and most of all in its radical, *amo*, "I love."

John Fowles is the author of The French Lieutenant's Woman. *Fowles, who has a strong interest in natural history, also wrote* The Enigma of Stonehenge *and is honorary curator of the Lyme Regis Museum in England.*



Volkswagen introduces luxury widebodies.

All seats first class.

With all the juicy enticements the airlines have used to get more people traveling their way, we thought we'd offer one of our own.

It's called the Vanagon GL. And it's first class all the way.

From the seven luxurious velour upholstered seats (each with arm rests), to the thick carpeting everywhere you step.

To the magazine pockets.

To the overhead reading lights.

To the European styling and color coordinated interiors in rich browns. Or royal blues.

Even the ride is nice. It has independent suspension and extra soundproofing to make any journey smoother and quieter.

Whether it's a trip to the Grand Canyon.

Or just down the street to Ralph's.

What's more, the Vanagon GL is incredibly fun to drive. All 200 cubic feet of it. It handles better than a lot of cars.

And, if you consider the optional diesel* engine, you might save enough money riding our way, to go just about onywhere you want flying theirs.

Nothing else is a Volkswagen.

© 1982 VOLKSWAGEN OF AMERICA INC

*EPA estimated 29 mpg. Use for comparison only. Actual mileage varies with speed, trip length and weather

Et tu, Tree Shrew?

Contrary to reports, the tree shrew is not on the roster of human ancestors. Its maternal instincts are decidedly unlike those of a primate

by Robert D. Martin

Tree shrews, inhabitants of the tropical forests of southern Asia, must surely count among the most misunderstood mammals. Confusion surrounding them is due in part to their name, for they have nothing whatsoever to do with the real shrews. Further, most species of tree shrews are much more active on the ground than in the trees.

The closest counterparts to the tree shrews in general appearance are squirrels. Indeed, outwardly the resemblance between the animals is so great that the same Malay word, *tupai,* is used for both the squirrels and tree shrews of the Malaysian rain forest. Some squirrel and tree shrew species resemble one another so closely that naturalist Robert Shelford suggested that there is mimicry between them, with the squirrels receiving protection against predators through their similarity to the relatively unpalatable tree shrews.

The diverse tree shrew family includes at least eighteen species, ranging from relatively large (up to fourteen ounces), exclusively terrestrial forms to a few quite small (five ounces) species, which can be genuinely described as arboreal. The common tree shrew, *Tupaia glis* —which can be taken as a typical, medium-sized member of the family Tupaiidae—is fairly similar in habits to the North American gray squirrel, showing considerable agility in the trees but mostly foraging on the ground. Like squirrels, all tree shrews bear well-developed claws on their digits and are typically active during daylight hours. Only one tree shrew species, the little-known pen-tailed tree shrew (*Ptilocercus lowii*), has definite nocturnal habits and is accorded its own subfamily to distinguish it from all other species. All tree shrews rely heavily on sight, and they resemble squirrels in having relatively large eyes. However, tree shrews do differ markedly from squirrels in their feeding habits: their diets are composed primarily of invertebrates (especially arthropods), supplemented by fruits and small amounts of other miscellaneous foods. Accordingly, they have relatively simple teeth with sharp cusps adapted for puncturing the external skeletons of their arthropod prey. Such prey are sought on the ground by most tree shrew species, which use their sharp claws and long snouts for rooting in litter on the forest floor.

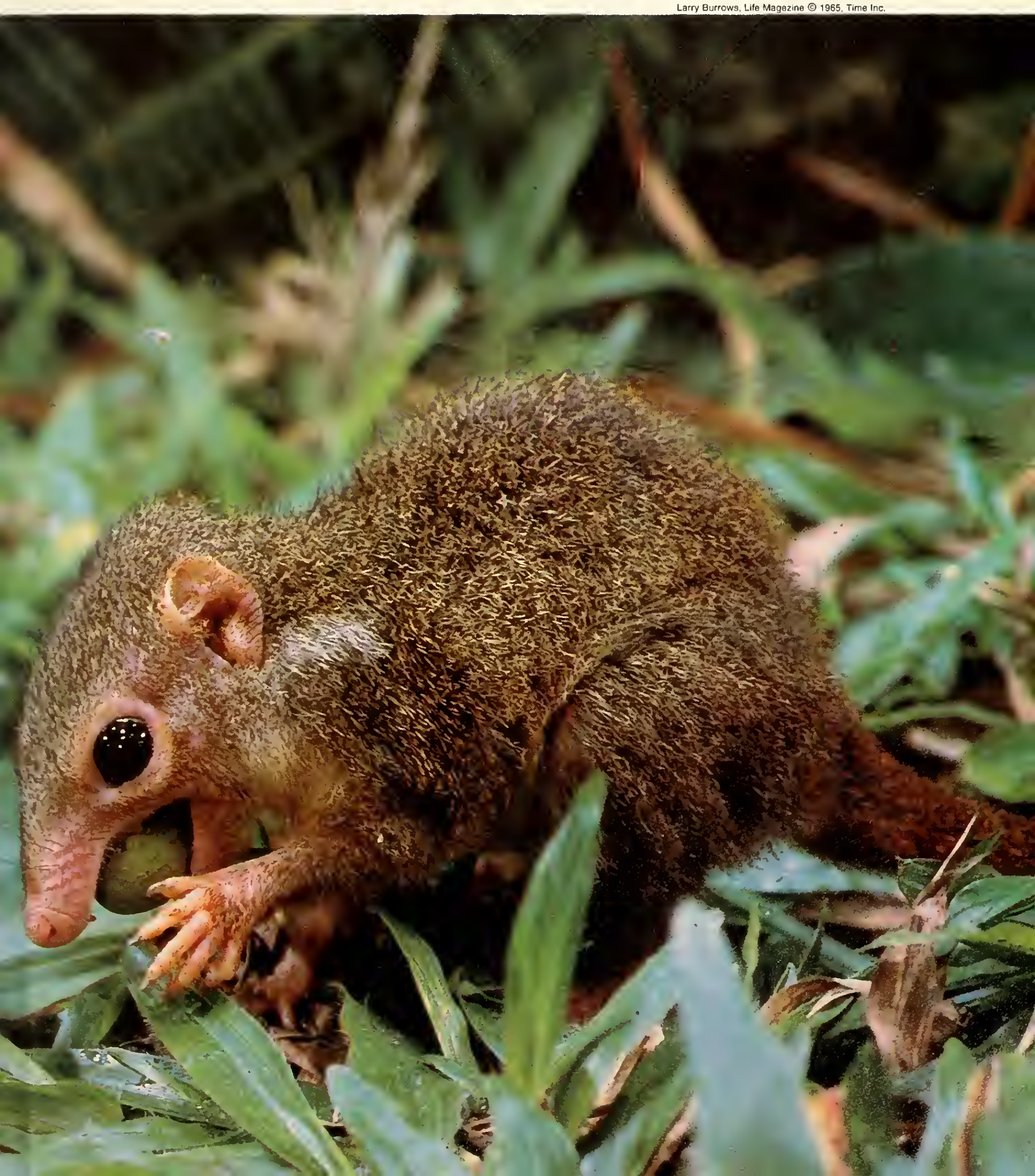
The first published description of a tree shrew dates back to 1780, when William Ellis, a surgeon who accompanied Captain Cook on his voyage of discovery through the Malay archipelago, provided a clearly recognizable sketch of a tree shrew, accompanied by a basic account of its anatomy and habits. Subsequently, because of their predominantly insectivorous habits, tree shrews were first placed in the order Insectivora, which was in reality little more than a wastebasket category for relatively unspecialized small mammals. They were later accorded some special status in 1866 by the German zoologist Ernst Haeckel, who divided the Insectivora into the Lipotyphla (typical insectivores such as shrews, hedgehogs, moles, and tenrecs) and the Menotyphla (tree shrews and elephant shrews). This division was based on the fact that tree shrews and elephant shrews possess a caecum (a blind sac in the digestive tract, located at the junction of the small intestine with the colon), whereas this organ is lacking in typical insectivores.

The tree shrews would probably have languished in comfortable obscurity but for the intervention of W. E. Le Gros Clark. In the 1920s, following his appointment by the British government to a medical post in the Far East, Le Gros Clark published a fine series of detailed papers on the anatomy of tree shrews, which dealt particularly with the skull, brain, and muscular system. On the basis of these studies, he postulated that the tree shrews are closely related to the primates (lemurs, lorises, tarsiers, monkeys, apes, and humans), and this bold proposal was given an official stamp of approval in G.G. Simpson's influential classification of the mammals in 1945, which included tree shrews in the order Primates.

Le Gros Clark's studies had highlighted a large number of undoubted similarities between tree shrews and primates, raising the exciting possibility that as the most primitive surviving representatives of the primates, tree shrews could be taken as a model for studying the early evolution of

Pygmy tree shrews eat a wide variety of foods in trees and on the ground. Their mobile, unspecialized hands are used to manipulate small food items, such as fruits found on the forest floor.

Larry Burrows, Life Magazine © 1965, Time Inc.



the mammalian group from which man himself ultimately emerged. As a result, tree shrews attracted increasing interest, culminating in the 1960s in the publication of numerous papers and books drawing attention to an impressive list of anatomical and other similarities shared by tree shrews and primates. By 1967, tree shrews had become firmly established as the most primitive living members of the order Primates.

It was against this background that I began my own studies of tree shrews. Having just completed a degree in zoology at Oxford University, where my interest in animal behavior had been fired by Niko Tinbergen's lectures and scientific papers, I had leaped at the opportunity to move on to the Max Planck Institute for Behavioral Physiology in Seewiesen, Germany, and work with Konrad Lorenz and his coworkers. There I had access to a laboratory colony of Belanger's tree shrews (*Tupaia belangeri*) from Thailand, established by Irenäus Eibesfeldt. Given the mounting interest in the young science of ethology (the comparative study of animal behavior), it was an obvious step to investigate the behavior of tree shrews in search of clues to the earliest origins of primate behavior. Since the study of any laboratory colony depends upon successful breeding, I naturally concentrated on reproductive behavior. This led me to make a series of disconcerting discoveries and eventually to suspect that tree shrews are not primates after all.

Prior to 1964, when I started my investigation, breeding successes with tree shrews in captivity had been mediocre at best, particularly because parents frequently devoured their own offspring. In order to maximize the likelihood of breeding, I kept pairs of tree shrews in very large (about 250 cubic feet) indoor cages furnished with several nest boxes apiece, in the hope that plenty of space and a variety of nesting sites would reduce the risk of cannibalism.

Eventually, during a routine early morning inspection of the nest boxes in one of the cages, I found two completely naked infants with their stomachs curiously bloated with milk. (Tree shrews normally have small litters of only one to three infants.) Surprisingly, although the infants had just been born, the mother was absent from the nest and did not seem at all disturbed by my examination of her offspring. I therefore settled down outside the cage to await her return to the nest. I was in for a long wait; two whole days elapsed before the mother went back to her offspring. By that stage, I was convinced that I had just recorded my first breeding failure, and my fears seemed to be confirmed when the female reemerged from the nest box and went off to groom herself in a far corner. Yet when I went to the nest it contained two obviously thriving infants, with their stomachs once again bloated with milk. Thus it was that I began to unravel the bizarre maternal behavior pattern of Belanger's tree shrew.

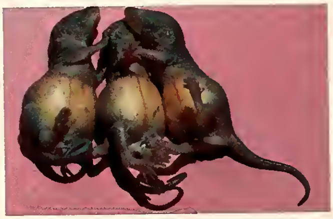
As the months passed, it became apparent that the female prepares a special nest for her offspring and visits them only once every forty-eight hours for five to ten minutes to suckle. The offspring remain in their nursery for about a month, then

*The common tree shrew of Thailand (*Tupaia belangeri*), like other tree shrew species, relies heavily on its sense of smell. Branches are marked with urine and secretions from skin glands. These scent sites may serve to reinforce the animal's home range.*

Robert D. Martin

In the laboratory, common tree shrews give birth to two or three infants, which are suckled only once every 48 hours, leaving their stomachs bulging with milk. This pattern of nursing may be the same in the wild.

Robert D. Martin



emerge as minor replicas of their parents. (In three to four months, they will be ready to breed.) Apart from her widely spaced suckling visits, totaling no more than one and a half hours for the entire nest phase, the mother exhibits no other direct parental care. Unlike the vast majority of nest-living mammals, the female tree shrew does not clean her infants, nor will she retrieve them if they become separated from the nest. In the absence of their mother, the offspring must keep themselves clean and must maintain a constant body temperature of about 98°F.

The details of this unusual pattern of maternal behavior were in themselves fascinating, but also extremely perplexing. Primates uniformly exhibit elaborate parental behavior, typified by frequent suckling, which establishes a strong mother–infant bond. They are outstanding among the mammals in this respect. Yet I was confronted with a tree shrew that obviously held the record for the absolute minimum of parental care among the mammals. This added special significance to the fact that tree shrews, along with other relatively primitive mammals, such as typical insectivores and most rodents, give birth to naked, poorly developed infants following a relatively short gestation period. Only after a period of development in the nest do such altricial infants reach the stage where their eyes and ears are open and their bodies covered with fur. Primates, by contrast, resemble other more advanced mammals such as ungulates (hoofed mammals) and cetaceans (whales and dolphins) in giving birth to well-developed precocial infants after a relatively long gestation period.

My own work confirmed earlier reports that Belanger's tree shrew has a short gestation period (about forty-five days), less than half as long as that of any primate of comparable body size. All of this threw doubt upon the supposed affinities of tree shrews with primates. Nevertheless, it was necessary to rule out the possibility that the bizarre maternal behavior I had observed was an artifact of captivity. Further, if such maternal behavior is truly of fundamental biological importance, it must be characteristic of the tree shrew family in general. On both counts, the absence of any previous reports of the peculiar maternal habits of tree shrews was worrying.

Various lines of evidence indicated that Belanger's tree shrews are naturally adapted for long suckling intervals, but the most convincing support came from analysis of tree shrew milk. Given the high energy requirements of the offspring for maintenance of their own body heat over long periods between suckling visits, it was predictable that the milk should have a very high fat content. Analysis of a milk sample taken from an infant tree shrew's stomach straight after suckling revealed a fat concentration in the region of 25 percent by weight. Such a high concentration of fat is paralleled only in certain aquatic mammals whose life in a watery environment similarly calls for high-energy milk. In milk samples from various primate species, by contrast, fat concentration has never been found to exceed 5 percent and is usually in the range of 1 to 3 percent.

An explanation for the lack of prior reports of peculiar maternal habits in Belanger's tree shrew was independently provided by elegant studies of the effects of stress in this species, conducted by Dietrich von Holst at Munich University. Tree shrews are particularly susceptible to stress in captivity, especially when overcrowded with adult cage mates of the same sex. Von Holst discovered that the degree of stress suffered by a tree shrew is reflected by the animal raising its tail hairs. (Photographs of tree shrews with beautiful bushy tails merely betray an adverse reaction to the photographers; unstressed tree shrews have smooth tails.) He was able to monitor different degrees of stress in captive tree shrews and found that reproductive behavior is sensitive to relatively low levels of stress and that maternal behavior is most sensitive of all. Even quite mild stress will disrupt tree shrew maternal behavior, with the surprising result that a stressed mother will suckle her infant *more* often than an unstressed mother; but the total quantity of milk supplied over a given period (for example, 48 hours) is markedly reduced.

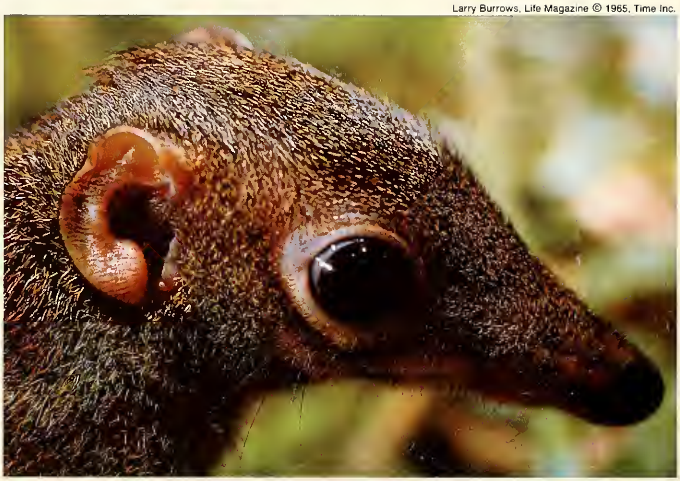
The frequent occurrence of cannibalism of Belanger's tree shrew infants was also explained by von Holst's results. He discovered that the mother marks her infants with an oily secretion produced by a special gland on her chest. If the secretion is artificially removed from the infants, their mother simply devours them. To complete the picture, von Holst found that secretion from the marking gland is suppressed by moderate stress. This explains why tree shrews, unless they are provided with optimal conditions in captivity insuring a minimum of stress, show a reduction in breeding success through cannibalism of infants and disruption of the regular 48-hour suckling rhythm characteristic of unstressed mothers. This latter point was neatly illustrated with a colony of Belanger's tree shrews that I maintained at University College, London. While one female was rearing a litter of infants, the fire-alarm bell was tested in the corridor outside (for only twenty seconds at a time) on two occasions, separated by an interval of a fortnight. On both occasions, the test was followed by a week-long disruption of the mother's 48-hour suckling rhythm, and the offspring emerged from the nest weighing 35 percent less than expected.

In due course, studies conducted by my colleague Frances D'Souza at the University of Reading demonstrated that the terrestrial tree shrew, *Lyonogale tana*, and the arboreal pygmy tree shrew, *Tupaia minor*, also exhibit peculiar maternal behavior involving a 48-hour suckling rhythm and a high-fat milk. Hence, the

Stouffer Enterprises, Animals Animals

Tree shrews combine a number of primitive mammal characteristics, such as claws, a long snout, and prominent whiskers, with specialized features such as large eyes. Although their visual sense is well developed, as in squirrels, their eyes are located on the sides of the head, in contrast to typical primates. (Both photos show the pygmy tree shrew, Tupaia minor.*)*

Larry Burrows, Life Magazine © 1965, Time Inc.



pattern of maternal behavior first discovered in Belanger's tree shrew seems to be a common trait in this family of mammals. This means that in terms of parental care there is a vast gulf between tree shrews and primates.

Just as suspicions were growing in my mind that tree shrews were actually very distinct from primates, a number of papers appeared in which interpretation of the anatomical evidence for affinities between tree shrews and primates was questioned. In particular, paleontologists Malcolm McKenna and Leigh van Valen pointed out that some of the resemblances between tree shrews and primates, notably in skull anatomy, proved to be illusory on closer examination. More important, however, was a revolution in the approach to reconstruction of evolutionary relationships. Biologists had, of course, long recognized that some animals may resemble one another because of independent development of similar adaptations to meet the same functional requirements (convergent evolution). However, few investigators recognized that even similarities traceable to common ancestry (homologous characters) must be interpreted with considerable care. When making comparisons involving a particular set of species, one must distinguish between homologous characters retained from the common ancestor of the entire group (primitive homologies), and homologous characters originating from more recent ancestral stocks giving rise to only a limited set of species (derived homologies).

In reassessing the evolutionary relationships of the tree shrews, therefore, I set out to distinguish clearly between those similarities shared with primates that might have been retained from the common ancestral stock of all the placental mammals and any similarities that could be attributed exclusively to retention from a specific common ancestor of the primates. A case in point is the caecum in the digestive tract. Since tree shrews and primates both possess a caecum, whereas typical insectivores lack this organ, this character had been cited as linking tree shrews to the evolution of primates. However, we are now virtually certain that the ancestral placental mammals already possessed the caecum as a heritage from their reptilian ancestors, and that this organ has been secondarily lost in a number of mammalian groups that do not require special fermentation of plant food—for example, the typical insectivores and carnivores. Hence, possession of a caecum does not provide evidence for a specific ancestral stock giving rise to tree shrews and primates; it is the typical insectivores that have lost the caecum as a secondary specialization.

Because modern insectivores (such as hedgehogs) are widely regarded as primitive mammals, comparisons aimed at establishing tree shrew relationships were in the past often restricted to a representative tree shrew species, a small number of typical insectivores, and a few primates.

When a female pygmy tree shrew comes into heat, she is receptive to her mate for just a few hours. During this time, she is followed persistently by the male, and mounting occurs frequently.

Larry Burrows, Life Magazine © 1965, Time Inc.

*The pen-tailed tree shrew (*Ptilocercus lowii*) is the rarest species and the only one that is completely nocturnal. Its scaly tail and membranous ears also mark it as quite different from other tree shrews.*

Larry Burrows, Life Magazine © 1965, Time Inc.

After researchers widened their comparisons to include other placental mammals and even marsupials, they found many of the features that supposedly link tree shrews to primates in other mammals as well, either because of retention from ancestral placental mammals or because of convergent evolution. This is particularly true of the relatively large eyes of tree shrews, which are associated with special features of the skull, such as the bony postorbital bar, and enhanced development of the brain. These features can be found in a wide variety of mammals other than primates; even the marsupial banded anteater closely resembles tree shrews in its eyes, skull, and brain. Not unexpectedly, semiarboreal squirrels possess most of the "primatelike" features of tree shrews that were originally emphasized by Le Gros Clark. The many similarities shared by tree shrews and primates can now be recognized as a mixture of retained ancestral placental mammal characteristics and convergent adaptations to meet similar functional requirements.

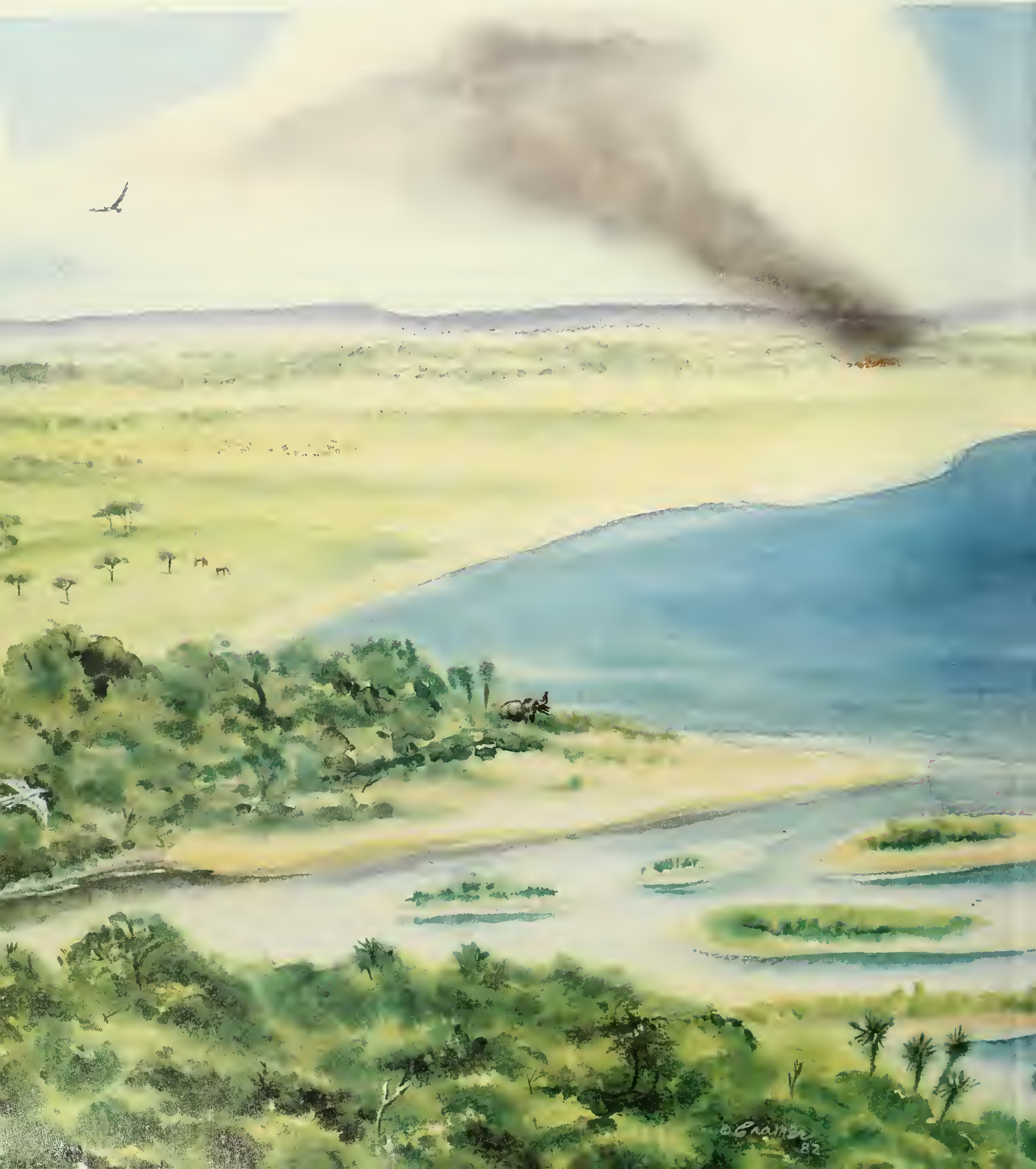
A wide-ranging reassessment of the tree shrews is provided in a recent book edited by W.P. Luckett, which fairly well rules out any definite ties with primates. Thus, in less than fifteen years, we have come full circle; the consensus now is that tree shrews are not relatives of the primates. It remains to be seen whether tree shrews are related to some other group of placental mammals. For the time being, many authorities place them in their own order (Scandentia), leaving this question open. Nevertheless, it does seem likely that tree shrews still have a special significance for future evolutionary studies, not as models for the earliest primates but as models for the ancestral placental mammals, by virtue of their retention of so many primitive mammalian features. Whatever else they may be, tree shrews are exceedingly primitive mammals.

For all the attention that has been directed toward tree shrews, we still know remarkably little about their behavior in the wild. Until recently, knowledge of the natural behavior of tree shrews was confined to incidental field reports. This gap has now been filled, to some extent, by a six-month field study of the common tree shrew conducted by Japanese zoologists Takeo Kawamichi and Mieko Kawamichi in the Bukit Timah Nature Reserve of Singapore. They showed that common tree shrews (close relatives of Belanger's tree shrew) have relatively stable home ranges of just under two acres in area. The range of an adult male overlaps the home range of a particular female to a large extent and also includes the ranges of a small number of juveniles. The majority of interactions between tree shrews seen in the forest involve encounters between paired adult males and females united by extensive range overlap. All of this suggests that common tree shrews are basically pair-living under natural conditions, in agreement with observations made in captivity that tree shrews are most effectively maintained in pairs and that breeding adults of the same sex are extremely intolerant of one another.

The Kawamichis usually saw tree shrews ranging alone during the daytime, and therefore coined the term solitary ranging pair for the social system of the common tree shrew. They also reported cases of territorial clashes between adults of the same sex and observed territorial marking behavior with the chest gland, as had previously been reported in captivity. Unfortunately, they were unable to collect information on the natural maternal behavior of their tree shrews, although they do comment briefly that underground nests are probably used for breeding. This, along with their confirmation that common tree shrews are predominantly sighted on the ground rather than in the trees, suggests that tree shrews are far less attached to trees than the great majority of living primates.

We must await more intensive studies, using modern techniques such as radio tracking, for definite evidence of the natural maternal behavior of tree shrews, but it will be most surprising if the bizarre complex of features reported in captivity is not found in the wild as well. Perhaps further field studies will also tell us why such peculiar maternal behavior has evolved in tree shrews. For the time being, we can only speculate whether this is a sophisticated antipredator device or a special adaptation reducing to a minimum any modification in the mother's daily routine imposed by the birth of her infants. For my part, I am inclined to believe that tree shrew mothers have simply hit upon an extremely economical way of avoiding the maternal burdens carried by other mammals, most notably by the primates, including the human female. ☐

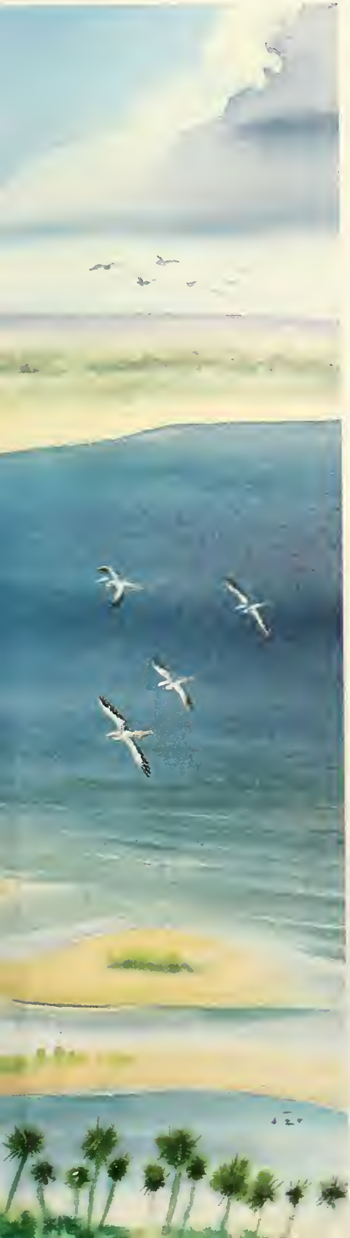
Five million years ago, the site of Sahabi was a mixed environment on the coast of the Mediterranean. As shown in this artist's reconstruction, dense forest surrounded the mouth of a river and adjacent swamps, while savanna mammals roamed grassland areas that were maintained by natural bush fires. Sahabi today, lower right, is a bleak desert location, but it is a rich hunting ground for paleontologists willing to endure hardship.



Fossils of the Libyan Sahara

The remains of the earliest hominids may lie in the sand-blown sediments of what was once a lush environment

by Noel T. Boaz and Douglas L. Cramer



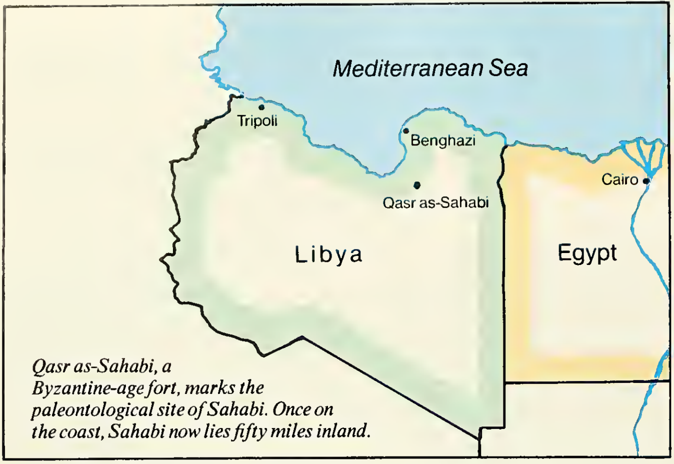
Sahabi, a paleontological site south of Benghazi and about fifty miles inland from the Libyan coast, is a place where one can feel the immensity of time: sand blows over the desiccating carcass of a caravan camel, a rusted World War II jerrycan, broken Roman potsherds, and scattered Paleolithic stone flakes. Anyone who walks through the Libyan Desert (part of the Sahara) day after day will find these and other discarded relics of past human endeavor. But the members of the International Sahabi Research Project have other reasons for enduring the debilitating noontime heat of summer, the winter deluges, the sandstorms, and the desert flies. Five million years ago, Sahabi was a mixture of subtropical savanna and forest, with streams that flowed into a complicated shoreline of swamps, lagoons, estuaries, and tidal channels. The area teemed with mammals—large and small, terrestrial and aquatic—as well as birds, reptiles, fish, and invertebrates. We have spent four years finding, cataloging, dating, and identifying what we now know of this fauna and flora, and our work is not finished, for the real quarry of the Sahabi Project has so far eluded capture. We hope to discover the ancestor of *Australopithecus*, the oldest hominid, or humanlike creature, now known.

Sahabi is today the best-understood and best-dated site in North Africa for the period of geologic time, beginning about 24 million years ago and ending about 1.6 million years ago, that comprises the Miocene and Pliocene epochs of the Cenozoic Era. This includes the preaustralopithecine time period, four to eight million years ago, when the ancestors of humans first stood bipedally and started on a new evolutionary path. Anthropologists do not know exactly when or how this transition took place. Nor do they have any details on the overall cranial shape, teeth, or stature of the creature involved, which remains unnamed because the available fossils for the crucial period are too fragmentary to be diagnostic. Apart from our own tantalizing discoveries, there are only a half-mandible and a single molar tooth from Kenya, found a number of years ago by teams from Harvard University and the University of London.

At Sahabi, we have walked and crawled over forty square miles, crisscrossing and retracing our steps in order to find all localities rich in fossils. Specimens have come mainly from the discovery and collection of fossil bones that have eroded out of exposed sedimentary outcrops and are lying on the surface of the

Douglas L. Cramer

AMNH



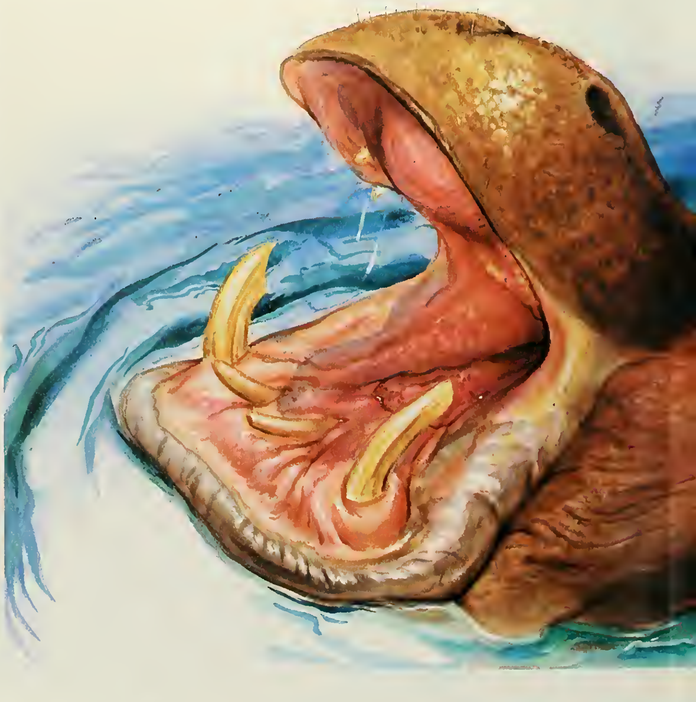
Qasr as-Sahabi, a Byzantine-age fort, marks the paleontological site of Sahabi. Once on the coast, Sahabi now lies fifty miles inland.

ground. We have excavated relatively few specimens, even though this might yield fossils in a very good state of preservation. Excavation is time consuming and labor intensive (therefore expensive)—and also risky: concentrations of bones at the surface frequently give misleading indications that there are fossils still buried in the ground. In our searches, we visit productive areas several times, under different light conditions, in order to see all collectable specimens, which include any skeletal elements identifiable by zoological family. As they are collected, all specimens are tentatively identified in the field and recorded in a field register, which is later coded and entered into a computerized catalog maintained at the Paleoanthropology Laboratory at New York University. Entries are updated as specialists, of whom there are thirty-five on the Sahabi Project, revise the preliminary identifications. Fossils from Sahabi have been carried or shipped all over the world for study, but eventually all will be returned to Libya, where they will be housed in a new museum at the huge complex of Garyounis University in Benghazi.

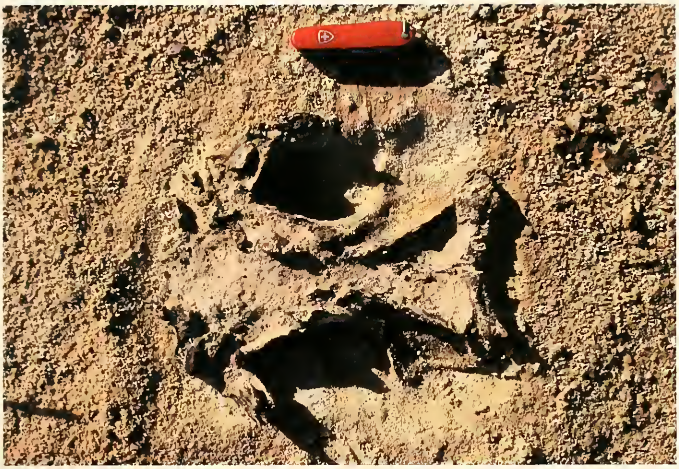
Paleontological interest in Sahabi began in the late 1920s, when patrolling Italian soldiers, stationed at the Byzantine-age fort Qasr as-Sahabi (*qasr* is an Arabic loan word from the Latin *castrum*, meaning “fortress”), found fossils in the area. Ardito Desio, an Italian geologist who explored much of Libya on camelback in the 1930s, organized the first studies at Sahabi. His student Carlo Petrocchi took over in 1934 and was responsible for most of the discoveries that first made Sahabi a well-known site. Chief among these findings was the skull and partial skeleton of a four-tusked mastodon, named by Petrocchi *Stegotetrabelodon lybicus*. It is still on display at the Tripoli Museum of Natural History and was featured on a 1978 Libyan postage stamp that commemorated the founding of that museum.

The Italian expeditions to Sahabi ended with the onset of World War II. During the war Qasr as-Sahabi was nearly leveled by tank fire, although it is still a discernible landmark. The paleontological significance of Sahabi remained obscure—the age of the site was unclear, no regional geology had been undertaken, and many of the fossils collected had not been studied or published (unfortunately, most of these seem to have been lost during the war). In addition, there were no small vertebrates, such as primates, among the known fauna, suggesting that the remains of large animals had been favored by the collecting method.

A reevaluation of the Sahabi *Stegotetrabelodon* by the American paleontologist Vincent Maglio in 1973 refocused attention on the site. Maglio’s provisional dating of the site, based on morphological comparison of the fossil to mastodons at other dated sites in Africa and Eurasia, was six million years ago, in the late



The underside of a fossil hippopotamus skull, lacking teeth, emerges from the Sahabi sand. Its owner, shown in a rendering below, resembled the living pygmy hippopotamus of West Africa, rather than the larger, common African hippopotamus.



Douglas L. Cramer

Miocene. This suggested that at Sahabi it would be possible to document the ancestry of the earliest hominids now known, the australopithecines, which in eastern Africa extend in time to about four million years ago. Sahabi also offered the opportunity to test biomolecular hypotheses that this was the time of the ape-hominid split. Discussions with Libyan officials and the establishment of a close liaison with Abdul Wahid Gaziry, a vertebrate paleontologist at Garyounis University, led to the formation of the International Sahabi Research Project and the reopening of investigations.

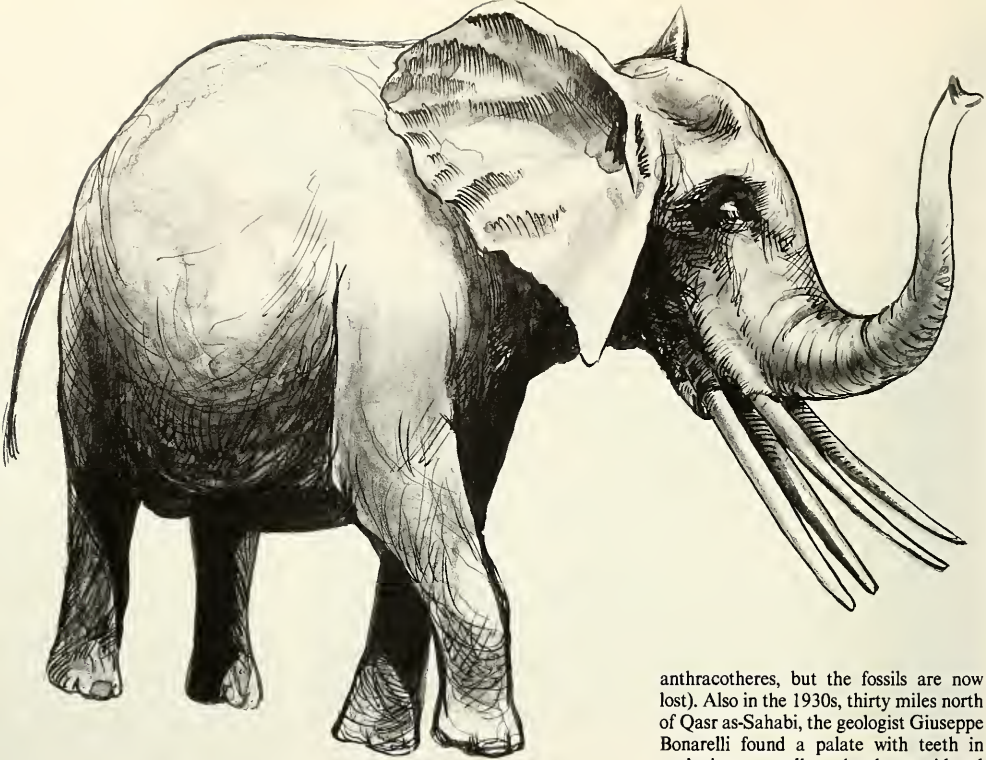
In 1978, the first full collecting season, a number of our initial expectations were borne out. We had assumed there would be small fossils at Sahabi, and we found, among others, a new small type of antelope about the size of the modern African dik-dik. We also found the remains of primates, including a monkey half-mandible probably belonging to the genus *Macaca*. There was also a second type of monkey, a *Libypithecus*, known previously only for Egypt. The discovery of monkeys confirmed that the environment at Sahabi, at the time a coastal location, had included habitats appropriate for higher primates. We now know from analysis of fossil wood that there were patches of swampy, water-tied forest mixed with areas of bush and savanna.

Scientists have theorized that the evolution of hominids in Africa was linked to the spread of savanna, and Sahabi offers evidence of this type of vegetation, both in the remains of such savanna animals as giraffes, horses, antelopes, and rhinoceroses, and in fossils of acacia trees (these trees are scattered about savanna environments today). Some of these fossil acacias show scarring by fire, significant because the ecology of savanna requires either natural or man-made fire in order to maintain open grassland areas and to keep trees sparse.

At Sahabi we had also expected to find animals with Eurasian affinities, because the Mio-Pliocene boundary (about five million years ago) was known to be a period of faunal exchange between Africa and Eurasia. In 1978 we discovered a bear tooth of the genus *Indarctos*, documenting this connection. It is the earliest record of the ursid family in Africa.

And of course we found things that we did not anticipate, which are in a sense the most gratifying and exciting of all scientific discoveries. At several localities we came upon abundant remains of sirenians—sea cows—many in large concentrations of semiarticulated skeletons. The Sahabi sirenian, about the size of a Florida manatee, proved to be a dwarfed form of *Metaxytherium*, also found in southern France at the site of Montpellier. The stunted growth of these creatures can probably be attributed to the high salinity of the Mediterranean during this time period, which must have affected the quantity or value of sea grass, their principal food source. The bones of *Metaxytherium* are frequently found cut by, and in association with, teeth of the great white shark, suggesting another drawback of their environment.

Another surprise at Sahabi was the presence and abundance of a primitive hippopotamuslike animal, the anthracothere *Merycopotamus*. The Italians working with Petrocchi had not reported any anthracotheres at Sahabi, although they had mentioned postcranial remains of hippopotamuses (possibly these were

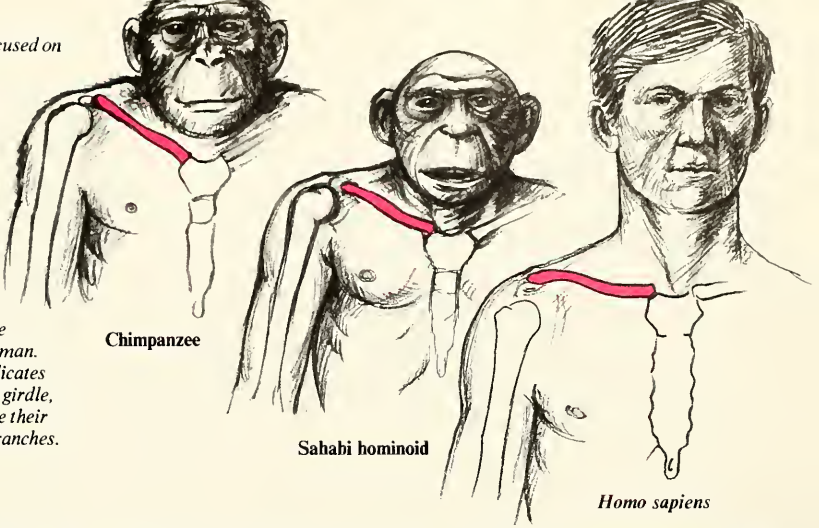


The remains of a four-tusked mastodon were among the finds that made Sahabi a well-known site before World War II. The animal probably used its lower tusks to dig up swampy vegetation for food. The photograph shows a mastodon skeleton being excavated in 1981. An upper tusk, with ribs scattered around it, can be seen in the center foreground.

John Page

anthracotheres, but the fossils are now lost). Also in the 1930s, thirty miles north of Qasr as-Sahabi, the geologist Giuseppe Bonarelli found a palate with teeth in geologic surroundings that he considered Cretaceous (between 135 and 65 million years old). In 1947 he named a new genus and species, *Libycosaurus petrocchii*, in the mistaken belief that he had discovered a new Cretaceous dinosaur. The palate was really that of *Merycopotamus*. Unlike earlier anthracotheres, the creature had large incisors, which made it resemble hippopotamuses. With more recent finds we have also confirmed the presence of a true hippopotamus, *Hexaprotodon*, similar to the West African pygmy hippopotamus and much rarer at Sahabi than *Merycopotamus*. We still are unsure how a hippolike anthracothere and a real hippo coexisted.

As work has continued at Sahabi there have been more surprises, including a mandible of a gerbillike rodent—our first indication of very small mammals—as well as various fossil birds, sabertooth cats, bears, hyenas, a seal, a dolphin, and the shovel-tusked mastodon *Amebelodon*. In all, some 4,500 specimens have been collected and cataloged, representing forty-five genera of vertebrates, at least twenty-five genera of trees and woody plants, and more than fifty genera of marine invertebrates. Sahabi is the only site in its time period with such a mixture of animals, from both wet and dry terres-



Attention at Sahabi today is focused on possible remains of early hominoids—members of the superfamily that includes both apes and humans. A fossil hominoid collarbone has been found that may have belonged to the ancestor of Australopithecus, *the oldest known humanlike creature. As illustrated, the angle of inclination of the Sahabi hominoid clavicle is intermediate between that of the modern chimpanzee and the human. A high angle for the clavicle indicates a high position for the shoulder girdle, characteristic of apes, which use their arms to hang and swing from branches.*

Douglas L. Cramer

trial environments. Other fossil sites around the Mediterranean preserve animals exclusively from savannas, or grasslands, such as horses, antelopes, giraffes, and rhinoceroses, while Sahabi also preserves animals that were swamp dwellers and denizens of forests or woodlands. Plant fossils have been found that allow an unusually accurate reconstruction of Sahabi's now long gone lush vegetation. And a rare feature is the record of offshore marine animals in association with these terrestrial habitats.

The association with the marine environment has tremendous significance for the dating of the site. Many faunal sites have been discovered in North Africa, but only one other has been dated in absolute terms, that is, in millions of years (and that one is older than Sahabi, dating to more than twelve million years ago). The problem has been that the most powerful tool for geochronology in this time range, potassium-argon dating, usually cannot be used. For the technique to be successful, potassium-rich rocks, such as volcanic rocks, must be present, but there are none at Sahabi and at most other sites in North Africa. However, workers in the laboratory of Belgian geologist Jean de Heinzelin have discovered the remains of Foraminifera in samples from the Sahabi deposits. The Foraminifera are an order of one-celled sea animals whose evolutionary stages have been systematically documented through time as part of the Deep Sea Drilling Project in the Mediterranean. The discovery of these and other planktonic forms provides an accurate means to date the terrestrial Sahabi sediments. Preliminary results suggest that the bulk of the Sahabi fossils are about five million years old, dating from soon after the Messinian event. This "event" was a period from about five and a half to five million years ago when the Mediterranean, cut off from the Atlantic Ocean, dried up, and only a layer of salt and a few hypersaline lakes remained in the basin. The Mediterranean later refilled rapidly when the basin was reopened at the Strait of Gibraltar, and it was this salty sea that bathed the ancient shoreline at Sahabi five million years ago.

The dating of Sahabi confirms the importance of the site for the study of early human evolution, for little is known about the period predating about four million years ago. The few fragments we have found of what appears to be a fossil hominoid—a member of the superfamily that includes both apes and humans—have therefore received our particular attention. In 1979, de Heinzelin picked up a longish bone at Sahabi that occasioned little interest at first. It was entered into the field register as a mammal rib, but looked strange enough to bring back to New York for comparative study. After many hours comparing it to specimens in the mammalogy collections of the American Museum of Natural History, we became convinced that it was not a rib at all, but a primate clavicle, or collarbone. It is a robust bone whose morphology does not fit any type of monkey we have documented at Sahabi or any other fossil or living monkey.

In size it is reminiscent of a pygmy chimpanzee, the living hominoid that probably most closely resembles the common ancestor of apes and humans. The shoulder of the creature was high, implying that the arm was used above the head, presumably for brachiation (swinging arm over arm, as apes do today). Yet the bone has a backward-S curve that is characteristic of hominids, implying that the creature may have been bipedal. The specimen was published in 1980 as "Hominoidea genus et species indeterminatus," since there was no way to estimate its exact affinities.

In 1981, we found a hominoid fibula (the outer bone of the lower leg) that may have belonged to the same type of animal. A preliminary analysis suggests that this leg bone would have been attached to a humanlike foot. Finally, we have found a piece of a hominoid skull that may also represent the same creature. It points to a brain smaller than that of today's pygmy chimpanzee, more like that of a robust gibbon. We need more fossils to determine whether these finds do in fact relate to the same species of animal, and we need teeth, jaws, and a face to help complete the picture. Only then will we know whether what we have found was the first hominid, or humanlike creature, the ancestor of the australopithecines.

As we continue to hunt for more evidence, one question that bedevils us is why fossils of hominoids are so exceedingly rare at Sahabi and in the fossil record generally. This topic has been addressed by Dorothy Boaz, our expert in the relatively new paleontological field of taphonomy, the study of how fossils come to be buried. Several reasons have been put forward. One stock answer is that many hominoids occupy forested habitats, and that the acid soil of the forest floor acts to disintegrate bones before they become fossilized. (And modern orangutan carcasses are scavenged almost

Daryl Domning, shown below excavating a fossil sea cow skeleton, hypothesizes that great white sharks preyed on the Sahabi sea cows. The association of their fossil remains and the evidence of shark bites on fossil sea cow ribs lie behind the artist's reconstruction, right.

Douglas L. Cramer

in their entirety by forest pigs.) Nevertheless, the fossil record documents many animals that were probably adapted to the forest. For example, in the Plio-Pleistocene deposits at Omo, Ethiopia, the remains of a forest gelada baboon and a bongolike antelope are common. And in the Early Miocene sites of the Kavirondo Gulf, Kenya, there are relatively abundant dryopithecine hominoids that lived in what has been reconstructed as a tropical forest. Even if the hominoids at Sahabi were adapted to the forest, we should expect to find them more highly represented in the fossil sample.

Another factor that determines the frequencies of different taxa in fossil assemblages is the original location of animal communities with respect to the sedimentary environments in which the bones of animals are buried. If the sediments that preserve animal bones are laid down by a river, for example, the animals living in or near the river will be better represented in the resultant fossil assemblage than those that live farther away. A possible explanation for the rarity of hominoids at Sahabi, then, is that they lived (and died) relatively far away from tidal channels, lagoons, and delta flats, and occupied instead the less wooded, more inland areas away from the riverbanks. The earliest known australopithecines did, in fact, live in savanna environments. This explanation is reasonable, for hominoids were certainly not members of the proximal community of Sahabi, as were anthracotheres and sirenians. But neither were three-toed horses (*Hipparion*), and they are found with regularity.

A third suggestion is that carnivores, particularly hyenas (of which there are several at Sahabi), chewed and destroyed the bones of many animals, depriving the fossil record of the bones of small-bodied animals, such as primates. But at Sahabi we do find the bones of monkeys, albeit frequently in gnawed condition. Since monkeys were presumably smaller than hominoids, we cannot account in this way for the scarcity of hominoid remains.

All of these factors have probably come into play to make hominoid fossils rare at Sahabi, although the creatures themselves may have been common. But we suspect that the primary factor that has prevented us from discovering a definitive hominoid fossil at Sahabi is simply chance. And on that optimistic basis, we will continue to battle various environmental, economic, and political obstacles so that we can return to the desert and carry on our search for evidence of this elusive creature. □

Regional parks encompass a wide variety of geographical areas and human habitations. Below are stone houses in a village near Bavella Pass, Corsica.

Bruno Barbey; Magnum

In Search of Past Harmony

In French regional parks, human inhabitants are part of the natural landscape

by Joseph L. Sax

To Americans the ideal natural scene is a wilderness, a place where—in the words of the Wilderness Act—"the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain." Insofar as practicality permits, most American parks show no evidence of human activity. Our attraction to untouched wild country is no accident. We perceive nature through the lens of our historical experience rather than from any ecological imperative. Exploitation has dominated our relationship to the land, and the unstated premise of the wilderness ideal is that when humans appear on the natural scene, they come as intruders and destroyers.

One need only imagine a collection of parks memorializing relationships between Americans and nature to appreciate the significance of our past: In the Upper Great Lakes region, a vast expanse of white pine stumps; in Appalachia, coal mines draining acid into the streams; in the Great Plains, a dustbowl; and in the west, a mountainside devastated by hydraulic mining. It hardly seems too strong to suggest that our parks are an act of expiation for past sins. More importantly, our past has left us believing that harmonious relations between humans and nature are not normal—that perhaps they are not even possible.

Since people and nature have so often been adversaries in the American experience, the management of our parks has been unceasingly troubled by conflict between human activities and the need to protect nature. As communities develop near parks, our routine response is acquisition of the land and displacement of the people. If facilities for the accommodation of visitors grow excessively, the standard recommendation is to relocate such places outside park boundaries. When visitor pressures increase, we either limit access or bar construction of additional facilities to serve the crowds.

Whatever the measures taken, the problems persist, changing form or location, but rarely diminishing and sometimes worsening. Land-acquisition practices, for example, have generated intense opposition from local residents, while re-

By retaining and restoring the traditional thatched-roof cottages in the Brière and Morvan parks, park administrators encourage a new generation to continue the craftsmanship of their grandfathers.

J.P. Durand, Atlas-Photo

moval of accommodations from within the parks has spawned a variety of tawdry tourist villages just beyond their borders. Reactions to burgeoning tourism intensify threats to natural resources if the response is developmental or elicit charges of elitism if access limitations are imposed.

While no one would suggest that human settlements should be imported into the midst of the great American wilderness parks, the problems remain of how to deal with those settlements that have developed along their borders and what to do about newer parks—such as those along the ocean shores and the Great Lakes—where communities existed before the parks were established. Our inclination is to push such communities as far away as possible, to minimize their impact on a park's natural resources if possible, and otherwise to view their presence as an unnatural burden troubling park management.

Imagine how different things might be if we began with the assumption that human habitats in and near the parks are as much a part of the natural scene as the park's flora and fauna, and that the basic task of park management is to harmonize those interacting communities rather than treating the human presence as an intrusion and a threat. Impossible? Wishful thinking? Perhaps. Yet that is precisely the idea upon which the extraordinary and little-known system of French regional parks has been created.

Each of these parks—there are now twenty widely scattered throughout the country—has been established in a remote but very attractive rural area. These are places that were left behind in the process of urbanization, industrialization, and agricultural modernization. Like such areas everywhere, they were suffering depopulation and drastically declining economies. Rather than applying the usual remedies, such as encouraging the entry of new industries and building new access highways, the French decided to make a virtue of adversity. The very things that made these places economic disaster areas—isolation, rugged landscapes, small-scale agriculture, and traditionalism—identified them as ideal destinations for urban visitors seeking a change of pace and place. Since these regions included communities that had lived for centuries in a sustaining relationship with the natural world around them, what could be more natural than the establishment of a nature park that included these communities, rather than ousted or treated them as intruders?

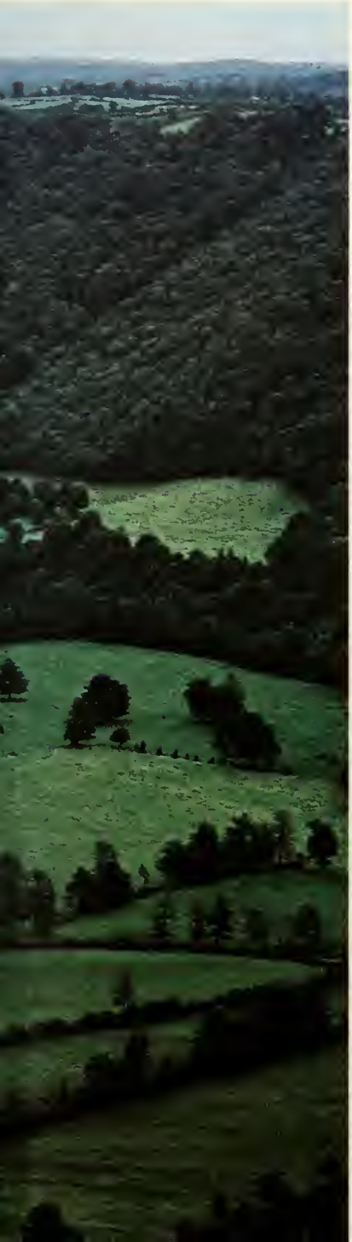
The administration of the new regional parks took on a dual function: to protect the natural resources of the area against deterioration and, at the same time, to economically revitalize existing communities, preserving what was best in the traditional way of life. With both people and resources within its mandate, an innovative approach to tourism evolved, creating a species of intermediate nature park that is virtually unknown in the United States.

The strategy is to encourage a constituency of visitors who seek neither a self-contained backpacking sort of experience nor the high-speed, high-energy style of

Ph. Roy; Explorer

An attractive rural area that has not kept pace with urbanization or the modernization of agricultural techniques provides an ideal setting for a regional park.

Cartier-Bresson; Magnum



Sheep graze undisturbed in Lubêron park in the Vaucluse section of France. Marginal agricultural economies are being revitalized by tourists attracted to the area.

Martine Franck; Magnum

vacation associated with elegant hotels or elaborate ski resorts. Local families are encouraged to let rooms to visitors in village houses and farms and to provide meals, somewhat along the lines of the bed and breakfast facilities in England. Not only does this avoid undue developmental pressures on natural resources and the need for substantial public investment, it also assures a flow of tourist dollars to community residents rather than to outside investors and brings visitors into direct contact with people living close to the land in traditional communities.

Since little land is acquired and few people are removed, the public costs are very modest and state intrusiveness is minimal. For example, the government has financed the establishment of a nationwide federation that publishes and distributes information about these lodgings (known as *gîtes ruraux* and *auberges rurales*), a substitute for advertising, which the owners could ill-afford but which informs tourists of the location of such facilities in each region, along with details about amenities, prices, and services. The government sets minimum standards of quality and also gives some assistance to owners in the form of education on the rudiments of running a public lodging. These, of course, are adaptations of the franchise technique, but without its dreary standardization or its industrialized features.

Activities for tourists are also developed in accord with the intermediate model. The focus is on those sports that utilize the region's natural advantages: hiking and riding, kayaking, fishing, and cross-country skiing. That these areas are inhabited is treated as an asset rather than an embarrassment. The extensive network of hiking trails, for example, is not limited to wildernesslike areas, but rambles through the midst of working farms and traditional villages before turning to the forests and up to the mountaintops. The impression of people as natural to the landscape, but not in a destructive relation to it, is powerfully conveyed.

The system of trail marking is itself indicative of the park administration's effort to encourage an intermediate constituency between the hardy backpacker and the vacationer imprisoned in his automobile. There is a nationwide system of color- and symbol-coded trail markers, which clearly designate turns and changes in direction. At places where one is tempted to take a wrong turn, there is usually a conspicuous X on the first tree or wall, a standard symbol indicating that the hiker has gone astray. While the system is perhaps too orderly for the adventurous, it has the significant value of saying implicitly that even people who are not fully at home in a natural setting should not hesitate to enter.

At some parks another device, borrowed from Germany, is being used to encourage more ambitious walking tours. For those who want to hike for several days and to stay in the chalet-refuges (dormitory-style cabins, with cots, blankets, and cooking facilities) that are scattered throughout the parks, arrangements can be made to have their gear transported by automobile so that it will be waiting for them at each evening's destination.

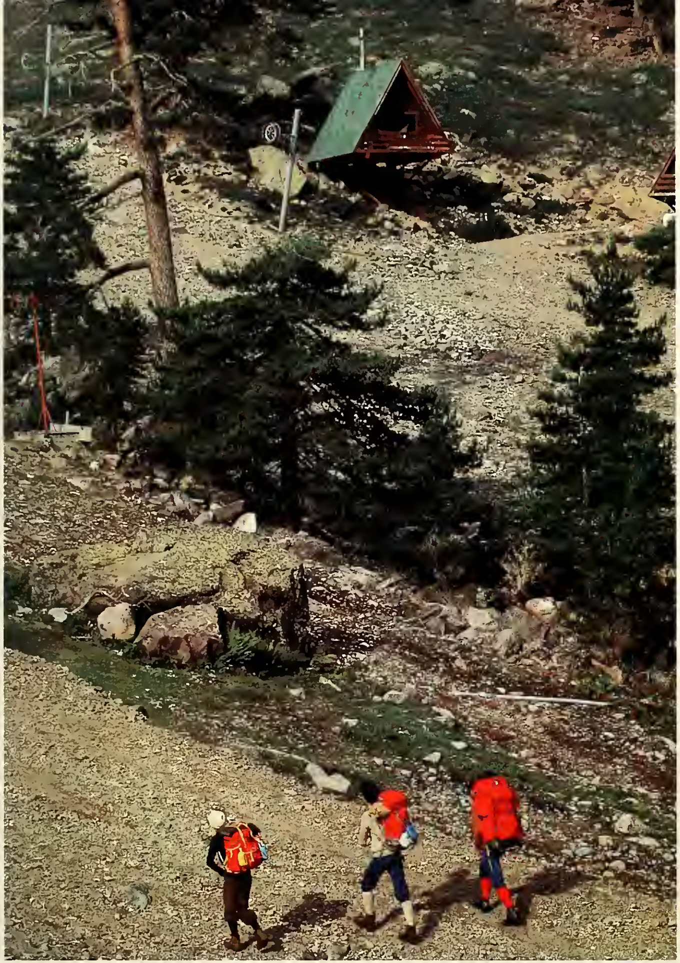
The parks administration is also much involved in reinvigorating traditional craftsmanship in the countryside. The government encourages the restoration of historic places, such as old churches, houses, or the vestiges of ancient forts and Roman walls. While these are rarely three-star attractions, they are of considerable interest. Restoration not only increases the potential flow of tourists but also provides work for local artisans and a much-needed flow of cash into the communities. As with the *gîtes*, there is a realistic recognition that public planning must take into account the need of the residents to earn a living, but all subsidies are designed to promote and maintain the traditional style of life rather than obliterate it.

One striking example is found in the regional park of the Morvan, an isolated region not many miles west of the Burgundy wine country. Among the features of the traditional Morvan village were thatched-roof cottages, the characteristic *maisons populaires* of the region. The thatch, made of ryegrass, at one time the dominant agricultural product of the area and especially suitable to its cold climate, typifies an older system where essentially all building materials were of local origin, where a use was found for virtually everything, and where construction was adapted to the local geography. The thatched roofs of the Morvan, sitting like hats atop the cottages, provided a cooling shelter in the summer and a warm insulator in the chilly winters. A distinctive style developed for the construction of the Morvan thatched roof, which when well made lasted for twenty-five or thirty years. Today, only a handful of these houses remain, and only a few older residents still know the techniques that were once a characteristic of the region. What remains is a unique illustration of popular architecture, one much more difficult to maintain than the castles and houses of the aristocracy.

Hiking trails may meander through villages and past working farms, taking advantage of existing roads. For the more adventurous visitors who wish to hike into the wilderness areas, chalet-style cabins scattered throughout the parks provide overnight accommodations.

Bruno Barbey: Magnum

The administration of the Morvan park has among its major goals the restoration of a number of thatched-roof cottages and the transmission of the old techniques to a new generation. To do this, it is aiding the owners in the costs of maintenance, encouraging the cultivation of ryegrass, subsidizing the manufacture of the special tools traditionally used, and educating a new generation in the craftsmanship of their grandfathers. All these efforts will add a bit to the troubled economy of the Morvan, while offering visitors the chance to see what the countryside was like when the inhabitants of every area lived off its indigenous resources. At the same time, of



Bruno Barbey; Magnum

course, the cottages will continue to be residences for local inhabitants.

Park officials recognize that a high degree of resource protection is possible only if traditional means of agriculture can be maintained, and that this is feasible only through affirmative action calculated to keep such farming profitable. A number of programs are directed to this end. In the Brière park in Brittany an agricultural adaptation of the enormously successful area-of-origin system for labeling French wines has been put into effect. If they meet certain conditions, products can be marketed under the official seal of the park, which states that "this product has obtained the label of quality of the Regional Natural Park of Brière." Such products must be of a certain predetermined quality, made in the traditional Brière manner, and marketed at a price and by a method of distribution approved by the park.

Other parks have adopted variant schemes with the same goal in mind. In the south of France, the administration of the Volcans regional park has organized a marketing association for traditional agricultural products (*produits à la ferme*). Park authorities in the Normandy-Maine regional park have agreed to pay half the cost of plantations of pear and apple trees for the manufacture of traditional fruit liqueurs, on condition that the communities cultivate them according to the traditional manner and supply the necessary labor.

In the Vosges du Nord regional park in Alsace, the administration provides free architectural assistance to those who want to build or restore houses, in order to encourage construction consistent with the style, traditions, and aesthetics of the region. Park officials provide consultative aid and participate in the allocation of permits whenever proposals are put forward for mining or quarrying within the park limits. There is also a range of elaborate educational programs for visitors, from workshops and guided tours to elegantly written booklets showing how to "discover" the region and its natural, cultural, and historic treasures. Many of the hiking paths have been developed in conjunction with detailed pamphlets illustrating geologic, floral, or archeological routes of discovery within the parks.

All these efforts build upon two assumptions fundamental to the success of the regional park: that there is in France a rural population that wants to live differently, to work in small craft industries, and to remain in settings more natural and less polluted than those found in big cities; and that there is a constituency of tourists who want to experience the authentic countryside and partake of genuine country crafts and foods. The evidence so far suggests that each of these premises is justified. Indeed, at a few of the regional parks success is beginning to produce its own problem, a superabundance of eager visitors. Whether the plans of the park administration will succeed depends ultimately upon whether the program of small subsidies, bolstered by enthusiastic encouragement, modest technical aid, and imagination, is enough to keep traditional life styles afloat economically.

Despite their successes to date, the parks are still far from fully achieving harmony between economic vitality and preservation of the environment in rural France. Much of the countryside, over the last half century, has been badly abused. Bad forestry practices are almost everywhere evident. Hardwood forests were cut down and replaced with fast-growing conifers that have in some places excessively acidified the soils. More recently, there has been a proliferation of weekend residences, built in patterns of suburban sprawl all too familiar to Americans, that desecrate traditional compact villages and put a heavy burden on the land. Productive fields have been exhausted and left to lie fallow.

Nor is conflict absent. Farmers have

A couple tending their sheep in a regional park in Corsica, below, and farmers plowing with oxen in Volcans regional park, right, are engaged in the traditional, small-scale agricultural practices that attract urban visitors seeking a change of pace.

Bruno Barbey, Magnum

shown themselves resistant to environmental protection, fearing undue restraints on their ability to use their land productively. Permanent residents complain that tourists and weekend vacationers have driven prices up out of their reach. At the same time vacationers, seeking a retreat to an idealized countryside, complain of farm odors, pesticides, and noise from agricultural machinery. Such problems are inevitable, for as one observer has noted, the countryside is not a museum but a mirror that reflects the reality of human relations to nature over time, a living—and not always beautiful—document of social history.

Whatever the ultimate balance sheet shows, the establishment of the French intermediate parks is among the most challenging and innovative efforts of recent decades to restore harmony between people and the environment in the practical setting of living communities. Whether the model France has created can be adapted to the United States is an enticing question. We have little that resembles the traditional village life of the European countryside, and our attachment to what the French call their "patrimony"—cultural, historical, and social—is a good deal less fervent than theirs. Facile attempts to transplant institutions from one culture to another are a hazardous business.

Yet there are some American situations where the French solution seems promising. One well-known instance is the Grand Teton National Park near Jackson Hole, Wyoming, where a neighboring cattle-ranching community has long provided a compatible complement to the park. In recent years, as urbanization and development grew and ranching declined, land-use conflicts between the park and its neighbors have intensified. Neither of the traditional solutions—land acquisition and zoning controls—has so far succeeded in arresting the problem. Among the key factors generating developmental pressures is a widespread concern among long-standing residents that traditional cattle ranching will not long continue as a profitable economic activity.

Had such a situation arisen in a French regional park, the first task would have been a search for some means to assure the continuation of ranching in the historic manner and to provide public support to residents who wanted to hold the traditional community together. Whether such efforts could succeed in Jackson Hole or in similar American settings remains problematic. At least one noble experiment along these lines is now under way in the New Jersey Pinelands, where a core resource-protection area has been yoked together with surrounding agricultural lands and towns and a commission created to promote a harmonious mixture of environmental protection and economic development. Thus far the plan has engendered something less than wild enthusiasm. Environmentalists remain suspicious of private owners who need to make a living from their land; the commitment to maintain traditional communities is fragile; and the temptation to view land as a commodity destined to generate maximum developmental profits is strong.

If there is any prospect of adapting to this country what is best in the French experience, it must begin with a change in the mission of park managers in those regions where human communities are already in place. So long as park officials are told that their responsibility ends with the park boundary, they will lack incentives to devise innovative programs to protect the resources within from outside threats. Moreover, as long as any such efforts fail to take into account the need of neighboring communities for a sustaining, as well as resource-protecting, economy, continued conflict between parks and their neighbors is certain.

If there is any indisputable truth about bureaucratic behavior, it is that administrators measure their success by the success of the mission the public has given them and tend to ignore the damage their actions cause elsewhere. Just as highway builders concern themselves with efficient transportation and neglect the disruption that roads may cause to park resources, so "resource-bound" park managers cannot be expected to attend adequately to the needs of nearby communities.

As harmony between people and nature becomes increasingly a central need in park management, the achievement of that harmony must become an explicit mission of park managers. Embracing an entire region within park boundaries, as the French have done, is not merely a symbolic act. When people and nature are interacting within a region, that entire area becomes the necessary ecological management unit, and its well-being, taken altogether, is the only test of success. ☐

Robert Valarcher, Atlas-Photo

Desert-nesting Sea Gulls

For the gray gull, rearing young in the desert is a safe but hot affair

by Thomas R. Howell

The Atacama Desert of northern Chile is as dry as any place on earth. In some areas rain falls only at intervals of many years, and in others no rain has been recorded within historical times. There are no freshwater lakes, ponds, or springs. In the total absence of available water, there is no vegetation whatsoever and thus not even the beginning of a food chain—not a blade of grass, not an insect, not a lizard. No life can exist there except for those animals that can travel for long distances to sources of food and water. The sky is nearly always clear, the only shade is that cast by rocks and boulders, and solar radiation is intense. Yet this arid and desolate locale is the only known nesting place of the gray gull (*Larus modestus*), a sea bird that, except for its breeding behavior, shares the way of life typical of other avian inhabitants of coastal waters.

Outside its desert breeding grounds, the gray gull is found only along the rocky and sandy Pacific coast of South America, largely south of the equator in the realm of the cold Humboldt Current, which flows northward from the sub-Antarctic. Within its range this species is usually the most abundant gull. It can be found along the coast at any time of year, frequently probing in the wash of the waves like a giant sandpiper, seeking small burrowing crabs (*Emerita analoga*) just below the surface of the shifting sand. Aside from its sandpiperlike foraging behavior, the general habits of the gray gull are similar to those of most other medium-sized *Larus* species. In fact, there is nothing especially distinctive about the gray gull except its nesting habits, which long remained a mystery. In his classic work, *The Oceanic Birds of South America*, published in 1936, Robert Cushman Murphy wrote that the nest, eggs, and even the breeding place of this common species were unknown to science. All that was certain was that the gull did not nest on the coast itself or on any of the offshore islands, and Murphy surmised that its breeding grounds must be somewhere in the largely uninhabited deserts of southern Peru or northern Chile.

Unknown to Murphy and the rest of the ornithological world, however, the nest and eggs had indeed been discovered. In 1913 an adventurous young Englishman named Alfred Johnson arrived in northern Chile to work for a nitrate-mining company whose mineral deposits lay in the barren Atacama Desert. An enthusiastic naturalist in a place of few diversions, he set about learning all that he could about the birds of the region and began making a collection of eggs. Decades later, in his own classic, *The Birds of Chile* (coauthored with J. D. Goodall and R. A. Philippi), Johnson himself told the story. For years, although he searched the coast and islands, the nest and eggs of the common gray gull eluded him. Inquiring among local people who knew the desert, he learned that the *garuma* (as the bird is called in Chile) nested only in remote places in the interior. In 1919, despite the difficulties of travel in those times, Johnson eventually found a colony of *garumas* in the rocky desert about fifty miles south-southeast of the port city of Iquique. Unaware that he was the first to do so, he made notes and collected three sets of eggs.

Only about twenty years later, when he saw Murphy's book for the first time, did Johnson realize the importance of his find. With his colleagues Philippi and Goodall, he set out again in 1943 and succeeded in locating another colony eleven miles west-northwest of Pedro de Valdivia in Antofagasta Province. This time the finding was reported in *The Auk*, an ornithological journal, in July 1945. I read the paper while an undergraduate student and filed it in my memory as a fascinating discovery in a remote part of the world that I would never see.

The fascinating part was not so much the finding of the nest and eggs but the location. How could a colony of sea birds exist in such a place, and what advantages could it provide for them? The adult birds would have to fly to the coast to feed, a round trip of at least two hours. Could they possibly leave the eggs or chicks exposed to full sun for more than a few minutes? All such questions remained uninvestigated.

By the mid-1960s, as an ornithologist at the University of California, Los Angeles, I had studied the adaptations of sea birds

Along stretches of the Pacific coast of South America, the gray gull is the most abundant gull. During the breeding season, however, the gulls form great flocks every evening and abandon the coast for their nesting grounds in Chile's Atacama Desert.

Mike Andrews

At sunrise, the desert is cool and incubating gray gulls sit comfortably on their nests. As temperatures rise, the gulls pant and ruffle their feathers to block penetration of solar heat.

Thomas R. Howell

to a variety of stressful environments. My sabbatical leave was coming up, and I remembered the gray gull. Alfred Johnson, now a businessman living in Santiago but still as enthusiastic an ornithologist as ever, responded cordially to my expression of interest. He cautioned, however, that no one had visited the *garuma* colony since 1943 and that it was but a speck in the desert; it might be difficult to locate or no longer in existence. Johnson's advice and personal contacts were invaluable, and in December 1968 (the austral summer) I found myself in the nitrate-mining community of Pedro de Valdivia in the Atacama Desert.

Everything began auspiciously. Oreste Hernandez, a mining technician who collected rocks as a hobby, had roamed all over the desert and knew of a *garuma* colony in the Pampa del Miraje (presumably the same one found by Johnson in 1943) less than an hour's cross-country drive away. The day after my arrival, he took me there, and gray gulls were all around, some in groups and others in pairs. It was going to be almost too easy, I thought as I drove back the next morning, but this time there was not a gull in sight. I spent the next several days searching what looked like a moonscape, actually a high, flat plain, or pampa, at an elevation of 5,900 feet. It was about twenty miles from the coast and separated from it by a low range of hills to the west. The ground was basically sandy but strewn with rocks of all sizes, up to large boulders. Driving over the less rocky parts was easy except that there were unexpected soft spots where the sand was as powdery as flour.

As the locality lies approximately on the Tropic of Capricorn, the sun was directly overhead at midday and even the largest rocks provided virtually no shade. It was blazing hot then, but at night the temperature declined rapidly and reached as low as 36°F just before dawn. Since there are no flies or scavenging insects, gull carcasses last for years and the colony site was littered with desiccated evidence of previous occupancy. A few wide-ranging turkey vultures sometimes appeared and followed me hopefully in my wanderings, and occasionally an Andean condor passed over, probably on its way to the coast. A migrant peregrine falcon from North America was around from time to time, preying on gulls, as I later learned.

Gulls appeared sporadically during the day, sometimes in good numbers, but did not stay. I became progressively more disheartened. Maybe they were abandoning the colony; maybe they would not breed this year. There were nest scrapes that looked fresh but no eggs and no evidence of continuous occupancy. I left to go to the coast for several days to learn what I could of their behavior there. Along the shore, the gulls fed during the day, loafed on the beach or the rocks, and courted as though on nesting territories, which they were not. Every evening they flew upward, formed great soaring flocks that disappeared as the light waned, and did not reappear until the next morning. After my last long day on the coast, on the way back to Pedro de Valdivia, I decided to detour across the pampa to the presumed nesting area. Arriving in late afternoon, I found not a single bird. Frustrated and discouraged, I started to drive away and promptly burrowed down in a soft spot in the sand. No matter, I thought; I will jack up the back wheels and put rocks under them. The jack, not previously tested, did not work. It was getting dark. Very well, I would spend the night and tinker with it in the morning. I was not well prepared; I had no food or water or warm clothes and I knew it would be nearly freezing by dawn, but those were only discomforts, not dangers. I curled up on the front seat and dozed fitfully.

Well after dark, I awoke and looked at my watch; only eleven o'clock and a long cold night still ahead. While half awake, I thought I heard the call of a gull. Suspecting my imagination, I tried to sleep again but now heard several more calls, louder and unmistakable. I could see nothing, but soon the cries were coming from all around and getting closer, and I began to hear the strange moaning and other sounds that meant courting birds on the ground. Within half an hour the noise had risen to a crescendo and showed no signs of diminishing. My flashlight beam panicked the birds, but even without it I could see them dimly in the starlight, gliding in and running around.

Despite the incredible volume of sound and my high level of excitement, I finally fell asleep some time after three o'clock and awoke to find the stars fading and the sky turning pale. Cramped and cold, I raised myself stiffly and looked out on an astonishing sight. During the night, in this improbable place of no precipitation, it had rained gray gulls. There were about two thousand of them—calling, resting, walking around, threatening, fighting, courting, making nest scrapes. By some wild chance, I had foundered my vehicle in the approximate center of the ultimate colony site. Later, when I measured and censused it at the peak of the breeding season, I found the area to be about 3.5 miles long by 0.6 mile wide and to contain an estimated 10,000 pairs of gulls.

Adults droop and slightly spread their wings over young chicks to protect them from the sun. This chick pokes its head out from the shade to receive food brought back from the coast and regurgitated by the adult bird.

Thomas R. Howell

Now, as the day brightened and warmed, I began to understand the situation. The gray gull was partly nocturnal, and at this stage of the breeding cycle, it occupied the nesting area primarily at night; continuous occupancy would come only after the first eggs were laid. Thinking that the gray gull, like virtually all other gull species, was diurnal, I had been confused by the casual and irregular site visits during the day. Although it was midsummer, nesting was just getting under way; from now on the birds would be increasingly abundant during the day as well as at night. And a few days later, I found the first egg. At last I had some basis for confidence.

Another year would pass, however, before I could conduct a full-scale study. In January of 1970 I was back in the gray gull colony, this time accompanied by Chilean ornithologists Braulio Araya and William Millie. We camped near the edge of the colony and erected a canvas bird blind within it because the gulls were wary. Artificial lights greatly alarmed them, but in the clear desert air the moon cast a brilliant light and at close range we could see the birds reasonably well at night. By working in shifts we could maintain continuous watches and thus witness their life cycle from courtship, mating, egg laying, and incubation through hatching and raising of young to an age of several weeks. Unfortunately, we were unable to remain until they were fully grown and ready to fly.

The gray gull resides in the desert only during the breeding season, and the early stages of reproduction begin on the coast. There the birds go through ritualized courtship and mating displays similar to those of such other species as the herring gull (*Larus argentatus*), made familiar especially through the studies of Niko Tinbergen. In 1962 ethologist Martin Moynihan had described the behavior of the gray gull on the coast; we therefore concentrated on its adaptations for nesting in the desert, which had never been studied.

We found that the same patterns of aggression, courtship, and mating behavior (including copulation) seen on the coast during the day are duplicated in the desert at night, but with greater vigor. This may be because the establishment of nesting territories and their defense evokes increased effort. We also found that despite the availability of a vast extent of apparently suitable habitat and the energy costs of defending territories, the birds cluster together. In a 328- by 328-foot area we counted 110 nests with eggs, and some nests were within 3 to 6 feet of each other. Adjacent pairs seem to learn the boundaries of each other's domains, however, and once eggs are laid, there is little territorial conflict. The nest itself is no more than a shallow scrape in the sand without any assembled materials, although small pebbles, feathers, or even weathered bones are readily available. The clutch usually consists of one or two eggs, rarely three. Most species of gulls lay three eggs and have a three-part, cloverleaf-shaped incubation patch—a bare area of warm skin on the underparts from which feathers are shed prior to egg laying. The few gray gulls that we examined in the hand had only a two-part patch. Small clutch sizes are characteristic of sea birds that must go long distances to feed and thus cannot provide for more than one or two offspring.

By continuous monitoring of marked nest sites, we were able to describe a typical day in the life of an incubating pair. Climatically, one day is much like the next. The sun rises at about six o'clock local time with air temperature at its lowest for the day. The incubating bird sits low and tightly on the nest, with its plumage compressed to an extent that minimizes escape of body heat. Temperatures rise rapidly in the sun: by ten o'clock the shaded air temperature is about 86°F, and

Past the age of ten days, gray gull chicks no longer need continuous shading. Both adults and older chicks often stand on rocks, which are cooler than the sand. If an adult is available, however, a large chick will try to squeeze under it.

Thomas R. Howell

surface temperatures in the sun are about nine degrees higher. The incubating bird hugs the ground less tightly and begins to ruffle out its back feathers, releasing body heat and increasing its insulation against insolation. If any nonincubating birds are present, they will move off the open sand and stand on a smooth-surfaced rock. This puzzled me until I took measurements and found that the sand absorbed heat more readily than did a smooth rock. The bird presumably feels the difference in temperature through its webbed feet. By standing on a rock with its feet in its own shade, the bird reduces its heat loading. Even in full sun, the surface temperatures of rocks we measured never rose above 111.2°, and if shaded, they quickly dropped below 104°. Sand temperatures in sun at the same time were more than 122°, above the upper limit of my thermometer.

By midday, solar radiation is at its peak, and even shaded air temperature has risen to 100° or 102°. All of the incubating birds are now standing and shading their eggs. These birds have not moved off their nests since dawn, so the scrape has not been exposed to direct sun. Although above the optimum for incubated eggs, the shaded air temperature is not dangerously high if it is not too prolonged. The birds' plumage is now fully ruffled out, even the short feathers of the head, providing maximum insulation from solar heat. The wings are drooped and held away from the body. The beak is open and the bird pants. With the sun directly overhead, the gulls face in random directions as there is no way to minimize exposure by turning one way or another. The air stirs only occasionally and slightly. There are still seven more hours of sun, and temperatures continue to rise. It does not seem possible that the birds or their eggs can survive unless something happens to break the heat.

Then it happens. From the west-southwest comes a sudden gust of wind, quickly followed by others, and soon a strong and steady wind is blowing at six to ten miles per hour. The effect is dramatic, for all the birds turn like weather vanes and face into the cooling wind. Temperatures begin to fall at once, especially in the shaded nests, and within minutes, as the shaded air temperature drops below 95°, the birds have settled down on their eggs again. The wings are retracted, the gaped beaks close, and the ruffled feathers begin to subside, although those on the back remain partly raised for some time. Overheating will not be a problem again until mid-morning of the next day. The wind slows in late afternoon and usually ceases by nightfall.

The onset of the wind about seven or eight hours after sunrise is regular and predictable. How does it happen to arrive every day just when it is needed most? Paradoxically, the very conditions of intense heat that require relief are responsible for the genesis of the wind. As the ascending sun heats the bare ground, the air above it is also heated and rises. This lowers the atmospheric pressure and eventually cooler air from another area moves in. In the pampa where the gulls nest, the flow of air comes roughly from the direction of the coast. Because of the constancy of desert conditions, the same sequence of surface heating and rising air is repeated every day. Presumably, land configurations influence the pattern of air flow, and the nesting gulls probably concentrate in areas most favored by afternoon winds.

The sexes share equally the duties of incubation, which begins with the laying of the first egg, and there is only one changeover of attending adults per twenty-four hours. One gull sits on the nest for all of the daylight hours and into the night until its mate returns from the coast, which may be as soon as one hour after sundown but is usually about two or three hours after, between ten and eleven o'clock. Awaiting the arrivals was one of the most enjoyable times for the observer in the blind. The wind has abated; the last, changing colors of the sky are beautiful; the incubating birds are tranquil; and the numbing cold of the late night has not yet set in. Before moonrise, there appear to be far more stars than the greatest number supposedly visible to the unaided eye. The return of gulls from the coast is signaled by loud calls from above, which are answered by birds on the ground, and soon the pampa resounds with their cries. We do not know exactly how the arriving birds locate their nest sites, but there seems to be individual recognition of the vocalizations exchanged between mates. They are not infallible, though, and we saw a number of instances in which an incoming bird approached the wrong site and was routed by a quick charge by the sitter. Most often the correct mate glided in and, after some vocal and postural exchanges, replaced the bird on the nest. The latter often departed at once, presumably heading for the coast to rest and feed before its next turn on the nest twenty-four hours later.

The incubation period lasts about twenty-nine days, a bit longer than usual for gulls. We were the first ornithologists to see the hatching and the live chicks of this species. We expected them to stay in the nest, safely in the shade of the attending parent, but instead they often left and wandered about in the hot sun. The adult gulls appear to be programmed to shelter only their nest site, for a parent would not move even a few inches from its empty scrape to shade its errant chick, which might be near heat death and in plain sight. Furthermore, a chick approaching an adult at a nest—the chick's own or some other—is advanced on and attacked with severe but not fatal pecks about the head. The assaulted chick at once assumes an extreme submissive posture with its bill tucked under itself and its nape exposed. This blunts the aggressive impulse of the adult, which returns to its nest. After a decent interval, the chick rises and moves again toward shelter. Any chick, whatever its parentage, is accepted if it can make its way into a nest scrape, and most of them do. One of our marked chicks turned up in five different nests and was gaining weight, which showed that it was accepted and fed. Within a few days after straying, however, most chicks end up in their original sites. Whether they are shading their own chick or that of another bird, adults protect young chicks from the sun by drooping and slightly spreading their wings to form a nearly perfect parasol.

The adults' responses to chicks in such situations may appear irrational to the human observer, but at least gray gulls do not cannibalize each other's chicks as do some other species of gulls. We could only conclude that, in the long run, the behavior of gray gull parents enhances the survival chances of their own offspring and that temporary acceptance of others does not diminish those chances.

How long is it possible for eggs or chicks to survive in full sun? We tested this by measuring their internal temperatures with battery-operated thermistor thermometers. The natural incubation temperature varies between 95° and 100.4° during the day and drops to about 91.4° at night. The range of natural internal egg temperatures is thus about nine degrees. We placed fresh eggs in unused nest scrapes in the sun and monitored internal temperature from late morning until late afternoon. An egg initially at natural incubation temperature would reach 107.6° or higher—a damaging or even lethal level—in less than one hour during the hottest part of the day.

There were two intervals of two hours duration, one in the morning and one during the windy part of the afternoon, when exposed egg temperature remained within the natural range of 91.4° to 100.4°. Nevertheless, because the minimum time for a flight to the coast and back is two hours, a gull could not safely leave its egg for a round trip and still have time to feed even if it chose exactly the right time of day. The 24-hour incubation span, requiring only a single round-trip flight, is doubtless safest for the egg and least expensive energetically for the adult.

To test the temperature tolerances of chicks, we built a small stone corral and placed chicks of various ages within it. Deep-body temperatures were recorded by inserting a plastic-sheathed thermistor probe down the esophagus to the stomach, a procedure easily tolerated by birds accustomed to swallowing chunks of fish. Newly hatched chicks weigh about one ounce and we estimated that they need about a week or ten days to reach a weight of 3½ ounces. When chicks smaller than 3½ ounces were kept in the midday sun, their body temperature increased rapidly and would reach lethal levels of 113°F or higher within half an hour. Under the same conditions, chicks larger than 3½ ounces did not heat up as rapidly and could keep body temperatures within tolerable levels for several hours by vigorous panting. Thus, beyond an age of about ten days, chicks do not need continuous shading by an adult, and we found that by about fourteen days an adult is no longer continuously present at the nest site during the day. Unattended large chicks stand on rocks during the hottest hours, as adults do. If an adult is present, large chicks will crowd under it for shade even if they can barely fit.

Food for the chicks is primarily fish, particularly the nutrient-rich anchovies that abound in the cold coastal waters. Feeding is by regurgitation, and disgorged morsels, either held in the bill or dropped to the ground, are avidly seized by chicks. Not all the food is given up at one time, for we sometimes saw chicks fed in the afternoon by a parent that had not been on the coast since the previous day. We found that one just-arrived adult was carrying 1.5 ounces of solid-pack fish in its esophagus and stomach. Young birds must be fed until they are able to fly well enough to reach the coast. It would be most interesting to know the full story of the maturation and departure of the young from the nesting colony, but that knowledge must await further investigation.

What are the advantages to the gray gull of its unique nesting behavior, which involves such risks in a harsh environment? The most obvious advantage is virtual freedom from predation as potential predators are few and scarce. Turkey vultures along the Pacific coast of South America are somewhat more predatory than their North American cousins, and there is some evidence that this species occasionally eats eggs of the gray gull. As mentioned earlier, a peregrine falcon regularly visited the pampa during our stay. We never saw it make a kill or even a serious pursuit, but we found a few gull carcasses with back wounds apparently caused by a falcon's strike. Desert-dwelling foxes of the genus *Dusicyon* inhabit northern Chile, and we found a few tracks and one desiccated carcass. Foxes could not permanently live in the waterless pampa, but a nomadic individual might locate the gull colony by the sounds at night and make a temporary living by feeding on birds and eggs and retreating into a burrow during the day. Finally, primitive man in early historical times may have been a predator. The pampa is crossed by still visible foot trails of ancient Indians who came from the interior to the coast to get seafood and salt. Gulls and their eggs would have provided welcome sustenance along the way.

Before modern humans, however, predation was most likely too slight and sporadic to cause much mortality, and relative freedom from predators was probably the most important advantage to desert nesting. The coast and nearby islands are permanently inhabited by the kelp gull (*Larus dominicanus*), a large and aggressive species that is a voracious predator on the eggs and young of other birds. It is a Southern Hemisphere equivalent of the lesser black-backed gull (*L. fuscus*) of the north, a fierce predator demonstrably capable of wiping out long-established colonies of smaller species.

But when did the gray gull begin to nest in the desert? The species' adaptations to desert conditions are primarily behavioral rather than physiological, which indicates that their origin may be relatively recent in geologic time. There is geologic evidence that the pampa where the gulls nest was covered by a lake in the Pleistocene period, perhaps 10,000 years ago. (The nitrate deposits were evidently laid down much earlier, about three to five million years ago.) Possibly the ancestors of the present-day gray gull nested around the borders of the lake and persisted even as the climate became drier and the lakes disappeared. At some stage, as food in the lakes became scarcer, commuting regularly to the coast to feed would have become necessary. The gradual conversion of lake bed to desert may have eliminated water-dependent predators, providing the gulls with a sufficient advantage to favor

Once the young gulls fly well enough to reach the coast, the parents' grueling daily trip from desert to sea and back again is no longer necessary. Away from its breeding grounds, the gray gull seems more like other gulls as it rests along the beach and feeds from coastal waters.

continued nesting in an increasingly arid habitat.

One nonbehavioral adaptation to desert conditions may be the largely dark gray plumage color, caused by melanin pigment. Melanin absorbs a broad spectrum of solar radiation, from infrared to ultraviolet. White feathers lack pigmentation and reflect much solar radiation, but they allow some to pass through (look at any white bird backlighted against the sky). If two opaque, solid objects, one black and one white, are placed in the sun, the black one will heat up faster. White feathers, however, are not opaque, and birds' plumage is not a solid structure but a complex of layers, including trapped air spaces that can be varied in thickness. Under certain conditions, melanized feathers can protect against heat loading better than white feathers. For example, heat is readily absorbed at the outer surface of the dark plumage and ruffling out the feathers increases the thickness of the insulating space between the outer surface and the skin. If heat can be continuously lost from the outer surface, the interior will be protected. Such heat loss can be caused by convection, as when air flows across the heated surface. The gray gull's system corresponds to this picture: the bird's ruffled-out gray plumage absorbs heat (direct or reflected) at the outer surface, and the afternoon wind dissipates the absorbed heat by convection, reducing penetration to the skin and deeper body tissues. Interestingly, two other gulls that experience environmental conditions similar to those encountered by *Larus modestus* are also largely gray—the lava gull (*L. fuliginosus*) of the Galápagos, which nests on sun-baked lava flows, and Heermann's gull (*L. heermanni*), which nests on desert islands off Baja California, Mexico.

When we left in February of 1970, the colony of gray gulls at the Pampa del Miraje appeared to be thriving, but since then it has been abandoned for unknown reasons. Belgian ornithologists Pierre Devillers and Jean Terschuren visited the site in February 1976 and found it deserted, and this was still the case as of 1981. In 1980, however, Carlos Guerra of the University of Chile in Antofagasta confirmed a report of a different nesting colony near Palestina, fifty miles inland in Antofagasta Province. Guerra and a BBC television team visited the site in January of 1981 and found a sparse colony with eggs and chicks attended by adults. The investigators' visit was brief, and as yet the birds' schedule of activities and the success of the colony are unknown.

Thus, there remains a great deal to be learned about the gray gull and the barren desert so critical to its survival. The gray gull's dependence on the Atacama Desert does not appear to be unique. Hornby's storm-petrel (*Oceanodroma hornbyi*) is another sea bird that apparently nests there too. This species is abundant at sea in the Humboldt Current zone, but active nesting sites have never been discovered. At present, the only clues are a few mummified birds found in the interior of Antofagasta Province. Clearly, this fascinating region has not yielded up all of its ornithological secrets. ☐

Hans D. Dossenbach

Special Pre-Season Offer!

CASHMERE MUFFLER
—$39.95

(while our supply lasts)

The choice Mongolian cashmere in this elegant muffler is incomparably soft, smooth, and supple. Wear it, and enjoy both matchless warmth and a striking look of luxury. 52″ long by 12″ wide, finished with the traditional Scottish scarf fringe.

Available in 6 tasteful shades: heather beige (oatmeal), camel, gray, burgundy, navy, and off-white. Special pre-season price is just $39.95, plus $3.00 for insured shipping and handling. (For deliveries in N.Y., add sales tax.) Satisfaction guaranteed, or return within 30 days for refund of full purchase price.

SAVE MORE! Order 2 or more and pay only a single shipping charge of $3.00. Include name and address of each recipient, and we'll ship gifts individually, with a card in your name.

For same-day shipment, call 800-221-2433 *toll-free*, to order by VISA, MasterCard, or American Express. In N.Y., call 212-889-0033.

Or mail check with your order to:
SAMUEL LEHRER & CO., INC., Dept. NH-1,
419 Park Avenue South, New York, N.Y. 10016.

Treasures From The Earth

Color Portfolio of Natural Specimens and Catalog of Minerals, Display Stands, Books and Natural Jewelry, $3.00

Dover Scientific
Box 6011C Long Island City, NY 11106

BAUSCH & LOMB

DISCOVERER
15 x 60 Scope
List: $399.95
Sale: $225.98

When it comes to optics, the Bausch & Lomb name has had no peers for over 100 years. Their binoculars, riflescopes and telescopes remain the standard of excellence against which all others are judged.

Invest in a Bausch & Lomb, and you've made the buy of a lifetime.

WRITE FOR LITERATURE AND DISCOUNT PRICES ON A COMPLETE LINE OF OPTICS FOR THE NATURALIST.

Danley's POST OFFICE BOX 1-E
FORT JOHNSON, N.Y. 12070

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: BOOKS-ON-FILE
Box 195 Dept. 72
UNION CITY, NEW JERSEY 07087

AUDIO-FORUM® offers the best in self-instructional foreign language courses using audio cassettes, featuring those used to train U.S. State Dept. personnel in Spanish, French, German, Japanese, Arabic, Chinese, Greek, and many others

Learn a foreign language on your own! Free catalog

Call or write Audio-Forum, Suite 702
On The Green, Guilford, CT 06437
(203) 453-9794

MATH WITHOUT TEARS

Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written.
Learn math in the comfort of your own home at minimum cost.

Order Now: $11.95 plus $1.25 hdlg.
EMERSON BOOKS, INC.
Dept. 572-G, Verplanck, NY 10596
10 Day Money Back Guarantee

Don't go without a single copy of NATURAL HISTORY

Now you can order back issues from 1970 to present.

Natural History, Central Park West at 79th St.,
N.Y., N.Y. 10024 Attn: Circulation Dept.

Date(s) of issue(s)________

Amt. enclosed ($2.50 per issue)________

Name________

Address________

City________ State____ Zip____

Please allow 6 weeks for processing

The Last Grand Victorian Expedition

by Gerald Carson

LOOKING FAR NORTH: THE HARRIMAN EXPEDITION TO ALASKA 1899, by William H. Goetzmann and Kay Sloan. *The Viking Press*; $17.95, 211 pp., illus.

When Edward H. Harriman, one of the great railroad executives of all time, was fifty years old and chairman of the board of the Union Pacific system, his doctor ordered him to take a rest. Characteristically, Harriman relaxed by venturing into a new field—philanthropy. He organized, paid for, and personally conducted a scientific expedition to Alaska on a chartered steamship that carried artists, photographers, nature writers, two doctors, and even a poet and chaplain as well as "the elite of the country's scientific establishment." John Muir, who was present, called the ship, the *George W. Elder*, "a floating university." The authors of this account identify the expedition as being at the end of the "second age of discovery," a period when exploration was conducted by professional scientists as distinct from the original adventurers of the fifteenth and sixteenth centuries, who voyaged in search of gold and glory and carried the cross. Harriman's expedition is characterized in *Looking Far North* as "perhaps the last grand expedition of the nineteenth century." In view of the date, the summer of 1899, this description can scarcely be disputed.

The expedition was designed as a serious effort to produce new findings of scientific value, while Harriman personally hoped to bag a Kodiak bear, the largest and most powerful of the species, and to assess the possibilities of a railroad con-

Members of the Harriman Expedition at Plover Bay, Siberia

Courtesy of the Bancroft Library

necting Alaska to Siberia as a step toward a line reaching around the world. Little is heard of this project in the narrative, so it must have been shelved after Harriman observed the Bering Strait.

On May 31, the *Elder* pulled away from the dock at Seattle; on board were twenty-three scientists covering twelve disciplines, with John Burroughs, the naturalist and author, as historian. The amenities were not absent—fine cigars and spirits, a piano, a gramophone that could both record and reproduce sound, a stock of books on Alaska. A Committee on Lectures provided substantial intellectual fare from a podium erected on the hurricane deck.

Wrangall, Juneau, the gold rush town of Skagway, Glacier Bay, the formidable Muir Glacier "glistening in blues and greens in the sunlight," then the *Elder* dropped anchor at Sitka where, Goetzmann and Sloan say, appreciating the ironies, "the Indians preserved their cultural artifacts by making them for tourists, whose presence contributed to the natives' cultural decline." Every time the ship stopped, sometimes for a few hours, sometimes for several days, shore parties landed to follow their specialties—photography and sketching; botanizing; collecting bird skins, insects, or marine life on the beaches; setting traps for specimens of animal life; sometimes charting a glacier.

A dichotomy, which the authors note carefully, appeared between the social Darwinists, generally the scientists, who saw a new frontierland rich in resources, and the conservationists, who saw a wilderness to be preserved. The same split developed when the expedition members were in contact with the native inhabitants. The humanists were filled with apprehension over the impact that civilization was having upon the natives. Edward S. Curtis, a serious student of Indian life recruited as photographer for the expedition by naturalist George Bird Grinnell, saw the Indian

CRUISE THE CROSSROADS OF THE CONTINENTS:

PANAMA AND THE CANAL

PLAN NOW FOR YOUR FALL/WINTER VACATION!

Planning a trans-canal cruise? Don't make any decision until you've reviewed our brochure . . . we give you more for your money than anyone!

Our unique cruise visits areas never before possible without our **Explorer Class™** vessel.

You'll discover the exciting **archaeology** and **cultures** that brought the world-famous explorers – Balboa, Sir Francis Drake and the colorful pirates – to Panama. See **Colonial Panama,** historic attractions, colorful **Indian tribes** plus beautiful **scenery, beaches** and **marine life** . . . all from the comfort and convenience of our new **Explorer Class™** cruise ship, featuring 44 air conditioned **staterooms,** each with private facilities. Plus, there's a picture-windowed **dining room** serving delicious hearty meals, a **lounge with** bar, and spacious **sundecks** offering an extraordinary view.

Varied ship and shore programs allow explorers of all ages to fully enjoy this extraordinary experience.

After the cruise, **extend your stay** with optional interludes at world-famous Contadora Resort and Casino, or at the brand-new Bambito Resort Hotel. Whichever program you choose, you'll **save on special package air fares.**

If you're considering any Panama Canal Cruise, send for our brochure first. We'll **really** show you Panama – in addition to the canal transit.

For best selection of stateroom and cruise date, **plan now, to obtain a free full-color brochure, see your travel agent, mail coupon below or call toll-free:**

800-426-0600
(in Washington State call 206/624-8551)

EXPLORATION CRUISE LINES™
1500 Metropolitan Park Bldg., Dept ACC, Seattle, Washington 98101
Please send me a free copy of your new Panama Cruise Brochure.

NAME

ADDRESS

CITY STATE ZIP

KNIGHT
PAWN
ROOK
KING
BISHOP
QUEEN

CAVEMAN CHESS SET

HANDCRAFTED, HAND FINISHED CAST PEWTER CHESS PIECES.

AMERICAN PEWTER & ANTIQUE BRASS FINISH \$95
HANDCRAFTED AMERICAN WALNUT & MAPLE CHESSBOARD \$80
SET: BOARD & PIECES \$170

FOR MASTERCARD & VISA CALL 800-824-7888 (OPERATOR 794)
IN CALIF. CALL 800-852-7777 (OPERATOR 794)

SEND CHECK OR MONEY ORDER TO

C·HASKELL·DESIGNS
for Metalworks

4108 ALCAZAR N.E.
ALBUQUERQUE, N.M. 87109

PLEASE ADD \$3 FOR SHIPPING & HANDLING

EWT
ExplorersWorldTravel

Serving prestigious organizations with reliable and exciting natural history tours, EWT is the specialists' specialist. Write us today for details.

Asian Wilds

New York Zoological Society
Leader: Dr. Archie Carr
Nov 26 - Dec 19 *$4650*

An intense wildlife safari to **Sri Lanka, India** and **Nepal.** Featured throughout is the endangered cat: tigers in exotic reserves like Periyar and Chitwan, leopards in Yala; and the timeless, forgotten wilderness of a subcontinent wrongly thought to be peopled wall-to-wall. Awesome scenery rafting through the Himalayas to Tiger Tops . . . Foreboding peace in the great herds roaming the endless meadows of Kanha. Dr. Carr is Asst. Dir. of one of the world's leading conservation institutes, the Animal Research Center of the N.Y.Z.S. His work on behalf of the world's rare and disappearing wildlife lends invaluable sensitivity to this delicate and beautiful tour of forgotten wildernesses. *("Forgotten Islands" — A Pre-Tour of the Seychelles and Maldives, November 15—26. $1550.)*

East African Safari

EWT Photography Field Seminar
Leader: Prof. Duncan McDonald
Jan 24 — Feb 14 *$3995*

Cameras long ago replaced guns in East Africa. Prof. McDonald, photographer, author, and on the Univ. of Oregon faculty, will offer optional seminars on safari during what would otherwise be free morning time, so that no gameviewing is lost. Geared to the beginner to near-professional, the program is ideal even if you don't bring a camera. Action photography, for the thrill of the Serengeti migrations; portrait photography, for the capture of a Maasai smile; landscape photography, for memories of Kilimanjaro and La Digue. **Kenya, Tanzania** and the **Seychelles,** with overnight in outer islands. Extensive gameviewing over customary routes. Perfect for the first-timer. *("Sudan & Ethiopia" — A Pre-Tour, January 15-24. $950.)*

Australian Safari

California Academy of Science
Leader: Dr. Robert Orr
Sep 18 - Oct 10 *$4950*

Space still available. Kangaroos and marsupials, rainforest trees from the ice age, birds more exotic than stuffed pinatas, breath-taking scenery. Arnhemland, Ahterton and Lamington, plus customary attractions.

Mail to: EWT, #3100, 8 S. Michigan Ave.
Chicago IL 60603

name ____________________

address ____________________

Interest in:
Asian Wilds ____ East Africa ____
Other Areas ____________

and Eskimo "in the sad process of acculturation," and his graphic anthropology "presented a cultural message" as his camera recorded such bleak scenes as tumbledown dwellings, deserted villages, and rickety sealing camps.

Harriman, representing the view that prevailed at the time in industrial America, was interested in the potential for cheap, abundant labor and hoped that the Aleut Indians could learn English and be converted to the Protestant ethic, which represented "Victorian America's view of the Indian's place in society." It was the *Rashomon* effect—the scene is the same for all, but the perceptions are different. Harriman and his guests were seeing two Alaskas.

At Kodiak Island the railroad financier got his bear, a female hardly of trophy size, and Captain Kelley of the *Elder* shot her small cub so that, at last, the taxidermists could break out their knives. The next day was the Fourth of July and we find the eminent Victorians of the expedition in a celebratory mood. The brass cannon was fired. There were recitations, speeches, and dances. The gramophone ground out Sousa's stirring march, the "Stars and Stripes Forever," and Charles Keeler, the poet, read an original poem denouncing the policy of the United States in the Philippine Islands. It was not well received, but the mood lightened when two colleagues performed a clog dance and everybody joined heartily in singing the doxology. At the end of the fete day the dead bears arrived in a rowboat alongside the ship and the members of the expedition raised a cheer. But a saddened John Muir viewed them anthropomorphically as "mother and child."

Thus, through incidents of the voyage, the authors develop the counterpoint between those who welcomed what they saw as an inevitable civilizing process and those who viewed what was already happening as, in the words of George Bird Grinnell, "corporate pillage." The topicality of the theme remains, of course, today. The Harriman Expedition, Goetzmann and Sloan point out, "is more than history. It is *déjà vu*."

The ship briefly dashed to the coast of Siberia by way of the Shumagin Islands. The landing was made at a desolate spot where the expedition members traded with the Eskimos—tobacco and glass beads for primitive souvenirs and native crafts, including pipes, harpoon heads, a walrus-hide fishing line, sealskin boots, and ivory hooks. On the return to Port Clarence, several of the company sat on deck all night to observe the midnight sun, while William Dall, the naturalist and an accepted authority on Alaska, described the Eskimo practice of killing their old women when they could no longer work, often at the request of the aged. Here the expedition made its northernmost penetration and turned south on July 13 for the return journey to Seattle. After passing Juneau and Douglas Island, the expedition located a deserted Indian village where nineteen weathered totem poles, ornately carved with birds, bears, and strange sea creatures, lined the shore. All were choice collectables and were loaded into the hold of the ship, to John Muir's profound disgust. And there was more booty. The village cemetery yielded a Chilkat blanket that had been spread over a grave. From the same place of interment, Harriman took for his personal collection a pair of carved wooden bears that guarded a grave. To commemorate the bonanza, a group photograph was taken in front of the village.

In due course the *George W. Elder* reached Seattle the morning of July 30 with its cargo of birds, mollusks, fossils, 3,000 insects, Indian artifacts, plants, and mammals, while personal baggage "bulged with souvenirs and trinkets." The expedition was recognized as a reconnaissance rather than a definitive survey of the region. Such work, indeed, had already been done by the U.S. Coast and Geodetic Survey and the U.S. Geological Survey. Yet the work of the Harriman Expedition was of sufficient importance that C. Hart Merriam, the head of the Biological Survey in the Department of Agriculture, who had assembled the scientific corps for the expedition, spent the next twelve years of his life editing and overseeing the publication of the results.

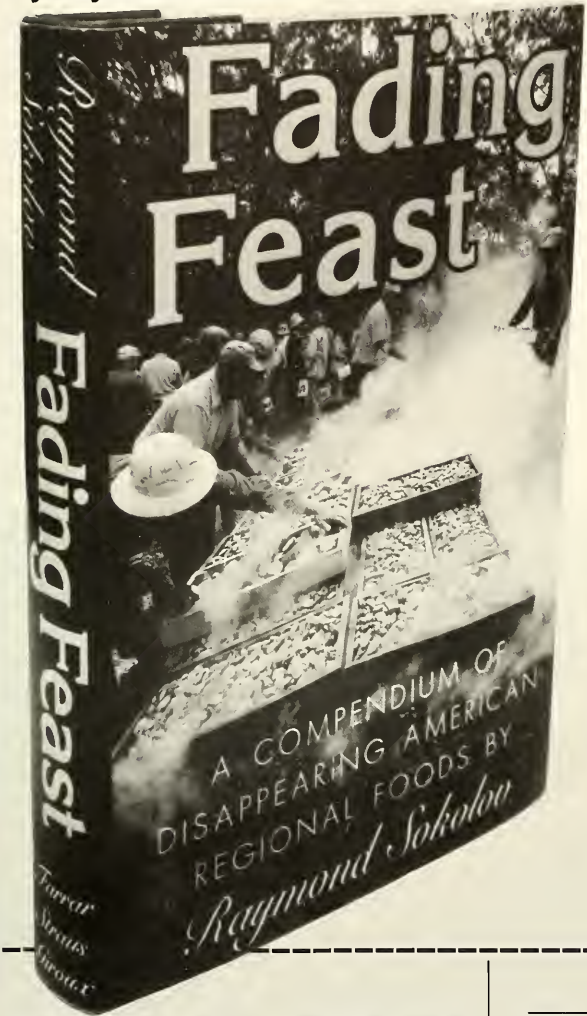
The first two volumes consisted of popular surveys by various authors, summarizing and interpreting their findings for a general audience, and were followed by a stream of later volumes presenting specialized treatments in detail "by scientists for other scientists." Goetzmann and Sloan have enriched their narrative with judicious quotations from the journals and other writings of the participants. The most interesting general idea they present recurs throughout the book—that the members of the expedition, with differing emotional and intellectual attitudes, constantly saw two Alaskas. As Grove Karl Gilbert, who has been called the "most philosophical of American geologists," put it, the observer "sees what he has eyes to see."

Gerald Carson, author and social historian, is a frequent contributor to Natural History *magazine.*

FADING FEAST

A Compendium of Disappearing American Regional Foods

by Raymond Sokolov



"A fine and unusual book...A beautifully produced volume."

—Cuisine

"An entertaining and intelligent field guide to such endangered species as Smithfield ham, Kentucky moonshine and country fair prize-winning apple pie."

—New York Times

"Passionate and literate."

—Smithsonian

"If you care about American cooking, as I do, you will find *Fading Feast* an enormously rewarding book."

—Craig Claiborne

On an unusual mission for *Natural History*, Raymond Sokolov crisscrossed America over the past few years in search of vanishing regional foods. From Puget Sound to Key West, Sokolov found old chefs and cooks who still practice early American customs in preparing traditional food. He talked with them, collected their recipes (over 100 are included) and preserved the culinary wisdom of our American past.

The culmination of Sokolov's odyssey is now gathered into a beautifully illustrated, hardcover book that has been widely acclaimed. These stories first appeared in Sokolov's popular food column in *Natural History*, and additional recipes have been added.

A special offer: Members of the American Museum of Natural History may purchase *Fading Feast* at a 20% discount off the list price.

☐ Yes, I would like to order _____ copies of *Fading Feast* at $17.95—20%, or $14.36 each. Please add $1.50 shipping and handling per order. ☐ Check enclosed

☐ Please bill my credit card account below

Credit card (circle one): MASTERCARD VISA

Acct No: ______________________

Expiration date: ______________________

Signature: ______________________

____
Name

____
Address

____
City

____
State Zip

Mail to: *Fading Feast*, *Natural History*,
Central Park West at 79th Street, New York, NY 10024.

Inside Jupiter's Rings

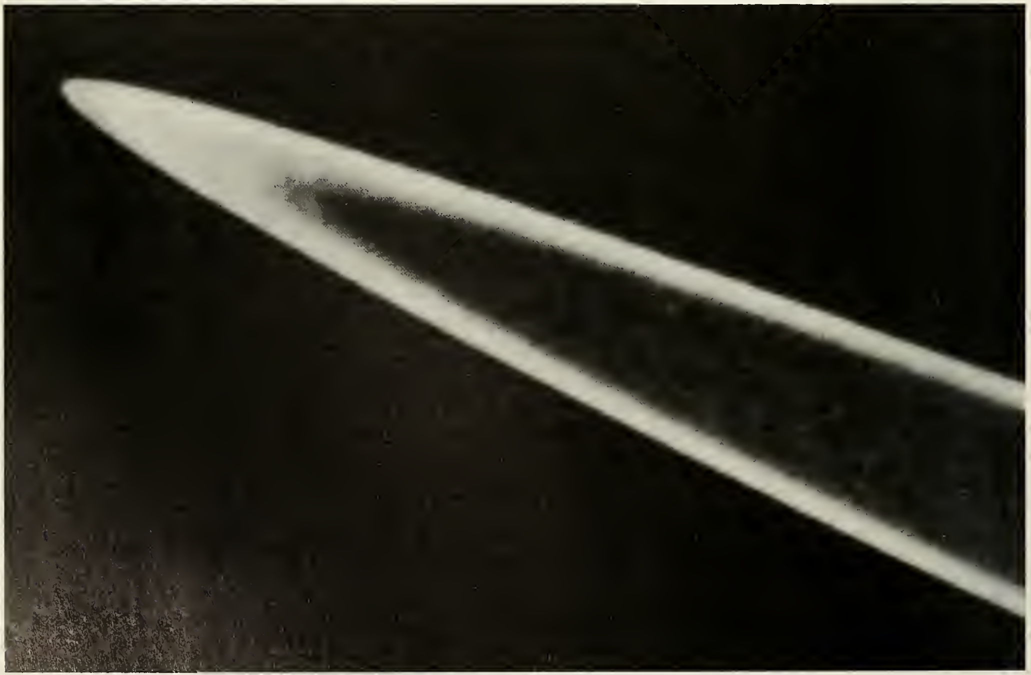
Do unseen objects nicknamed "mooms" supply the planet's recently discovered rings with their constituent particles?

by Stephen P. Maran

Until the *Voyager 1* and *2* spacecraft flights of 1979 sent back relatively close photographs of the distant planet Jupiter, astronomers did not know that it had any rings at all. Now, scientists have learned that it has two or more. In addition, further study has revealed that powerful forces, including drag and high-energy particles, are continuously eliminating the material that makes up the planet's rings, and yet the rings remain. Investigators working on this puzzle have concluded that the rings are being replenished with new particles from as-yet-unseen parent bodies, which have been dubbed the "mooms" of Jupiter.

An amalgam of moon and mom, the term moom was coined in the fall of 1979 by Joseph A. Burns, an expert on planetary rings at Cornell University in Ithaca, New York. Mom, of course, indicates that the object is a parent body. Two of the known Jovian moons may be mooms as well, in which case not all mooms are unseen, but a great many other mooms, with diameters of from one-half inch up to perhaps six miles, are also posited to exist.

Jupiter's rings are much harder to see than the famous rings of Saturn. Saturn's rings are densely filled with light-colored, roughly snowball- to basketball-sized lumps of ice, and thus they reflect sunlight well. The Jovian rings, by contrast, are composed mostly of widely spaced, small, dark mineral particles that are poor light reflectors but good forward scatterers. Don't let the term forward scatter confuse you, for it refers to a physical process that nearly everyone has seen in action. For ex-

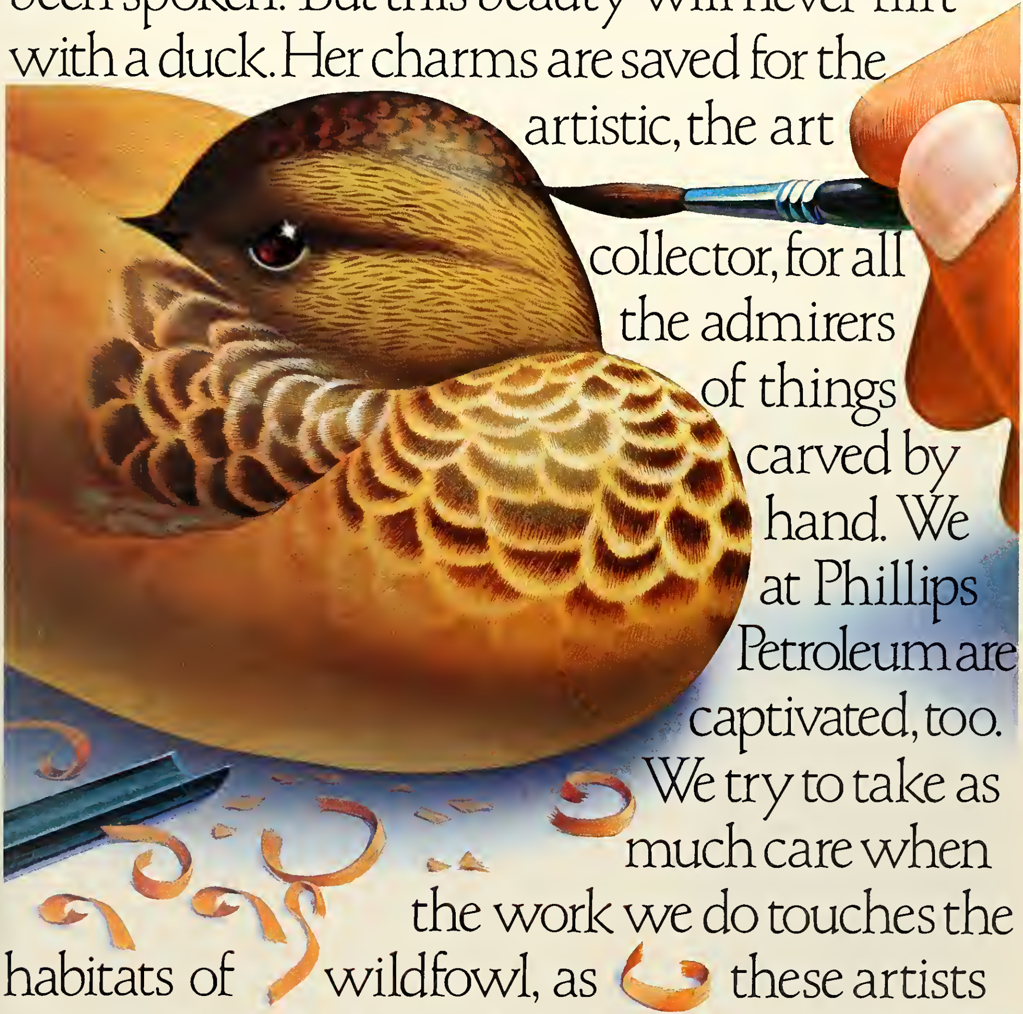


NASA

Jupiter's ring system, seen in this photograph taken by the space probe Voyager 2 *in July 1979, extends out to a distance of 1.81 Jovian radii from the center of the planet.*

Too pretty to get its feet wet.

Shaving by shaving, feather by feather, a wood block takes on life. The shaping of decoys has been a skill in Louisiana for as long as Cajun has been spoken. But this beauty will never flirt with a duck. Her charms are saved for the artistic, the art collector, for all the admirers of things carved by hand. We at Phillips Petroleum are captivated, too. We try to take as much care when the work we do touches the habitats of wildfowl, as these artists take with their birds. To every last feather.



PHILLIPS 66

Transport yourself to a world no one has ever seen

With the informed accuracy of scientific knowledge, coupled with an unerring and talented hand, Charles Robert Knight recaptures the extraordinary creatures and environments of prehistoric eras that no living human being has ever experienced firsthand. In this landmark volume of this master's paintings and drawings, with over 150 full-color and black-and-white plates, we can experience Knight's astounding vision of our own prehistory.

Dinosaurs, Mammoths, and Cavemen
The Art of Charles R. Knight
Sylvia Massey Czerkas & Donald F. Glut
8½" x 11", illustrated throughout
$24.95, cloth; $14.95, paper
DUTTON 2 Park Ave., N.Y., N.Y. 10016

Enjoy the romance. . .
Send for a luxurious color catalogue of beautiful lingerie. French bra and bikini sets, lacy teddies, gowns, kimonos & much more.
Victoria's Secret
designer lingerie

Send $3 to Victoria's Secret, Dept. NH-08
Box 31442, San Francisco, CA 94131
Boutiques in San Francisco, Palo Alto & Cupertino, CA

ample, when you look toward the back of a movie house from the front row, forward scattering is what makes dust and smoke particles appear as bright motes in the projector's light beam. If larger objects, such as bats and birds, were to fly through the beam (in which case, I suggest you patronize another theater), they would be seen in dark silhouette from the front row, although brilliantly lighted as viewed from the projection booth. Birds, bats, and lumps of ice, in summary, are reflectors, while dust particles are forward scatterers.

The first of Jupiter's rings was discovered on a photograph made by the NASA space probe *Voyager 1* on March 4, 1979. Although the photo was taken in order to search for a Jovian ring, few if any scientists seriously expected to find one. In retrospect, we might have been better prepared. Four years before, two physicists, Mario H. Acuna and Norman F. Ness of the Goddard Space Flight Center, in Greenbelt, Maryland, had analyzed measurements of Jupiter's magnetic field and of trapped radiation in the planet's Van Allen belts, as obtained by an earlier NASA probe, *Pioneer 11*. They found two regions of reduced radiation where an unknown object or objects might be blocking the flow of high-energy atomic particles. The physicists suggested that this could be a consequence of "an unknown satellite or ring of particles" circling Jupiter at about 1.83 Jovian radii from the planet's center. (The Jovian radius, measured at the planet's equator, is about 45,000 miles.)

In a published article, Acuna and Ness were careful to call their suggestion a "remote possibility," although in private correspondence they were more positive. We now know, from *Voyager 1* and *2*, that Jupiter's rings extend all the way from the planet itself out to a distance of 1.81 Jovian radii, in good agreement with the suggestion of a ring at 1.83 radii. The physicists were therefore right, although few thought so in 1975. On the other hand, a Soviet astronomer who claimed to have discovered a ring around Jupiter years ago was not believed then and is not believed now. He interpreted the Equatorial Band, a thin, dark marking occasionally seen on the planet, as the shadow cast by the ring on Jupiter. But the narrowest shadow that could possibly be seen from the earth is much wider than the shadow that Jupiter's rings, as we now know them, can cast. The Equatorial Band must have another explanation.

The *Voyager 1* photographs were obtained looking toward Jupiter with the sun behind the space probe. Thus, the first ring discovered (now called the "bright ring") was observed in the reflected light of the sun. Soon after the discovery, operations scientists at the Jet Propulsion Laboratory in Pasadena, California, began to plan a sequence of photos that *Voyager 2* would make to better study the ring when that probe went by Jupiter in July 1979. These were the photographs that showed that more than just the bright ring is present. The most spectacular photos of this sequence were obtained on July 11, two days after *Voyager 2* made its closest approach. Taken as the probe went through the long shadow cast by Jupiter, and with the camera aimed back toward the sun but off slightly to the side, the photographs revealed Jupiter's rings sparkling brightly in the forward-scattered sunlight. Initial inspection showed that the bright ring marks the outer edge of a ring system at 1.81 Jovian radii and is sharply bounded at that edge. Its inner edge, however, is diffuse, so that the bright ring grades into a second feature, or "faint ring," so called because of its relative dimness. Unlike the bright ring, the faint ring is not a narrow band but is thin and flat, like a phonograph record. It extends all the way down to the atmospheric layer that constitutes the visible surface of Jupiter.

Painstaking, computer-aided analyses were needed to extract the maximum amount of information from the *Voyager 1* and *2* photos and to obtain definitive measurements (as opposed to provisional data) of the rings. Indeed, important aspects of this work are still under way. The first definitive results were prepared by David C. Jewitt and G. Edward Danielson, planetary scientists at the California Institute of Technology in Pasadena. They discovered a tenuous halo that extends about 6,000 miles above and below the rings, which are themselves less than about twenty miles thick. The Pasadena results were not published in final form until September 1981. In the interim, however, many interpretations and theories concerning Jupiter's rings, some perhaps too hastily conceived, were proposed and published.

Jupiter's rings pose these questions to theorists: What created the ring system? What causes its present form of bright ring, faint ring, and halo? What maintains the rings despite processes that act to destroy them? The answer to the last question may hold the key to the others as well.

The *Voyager 2* measurements of forward-scattered light from the rings tell us that they contain an abundance of particles with typical diameters of only about 1/5,000 inch. The *Voyager 1* (and some

Voyager 2) photos made by reflected sunlight show that larger particles (at least two or three times bigger) are also present. Jupiter, like the rest of the solar system, is about 5 billion years old, but the small ring particles can only survive for a tiny fraction of that time, namely a century or so, without being destroyed.

One process that destroys ring particles is sputtering, the knocking away of constituent atoms from a mineral grain or other object by high-energy radiation. The Jovian Van Allen belts constitute an intense radiation environment, as proved by *Pioneer 10*, the first space probe to visit Jupiter. It suffered a radiation dose that would have killed an astronaut, had one been aboard. Calculations show that the belt radiation of Jupiter will sputter a 1/5,000-inch ring particle down to infinitesimal size in a mere century. Hence, if the rings have persisted, as we assume they have, over the eons of astronomical time, there must be a continuing supply of particles.

Larger particles can endure sputtering for longer periods, but another process, drag, brings them to their doom as well. It was a form of drag, namely the resistance of the earth's upper atmosphere, that forced *Skylab* to spiral downward, at first very slowly, then faster and faster, until it plunged to earth, some pieces falling on Australia. High above Jupiter's surface, there is an electrified atmosphere, the plasmasphere, that reaches out through the rings. Consisting mostly of electrons and protons, the plasmasphere produces drag on the ring particles, causing them to spiral in toward Jupiter. Most of the smallest particles don't make it all the way to Jupiter, sputtering away before getting there, and some of the larger ones are destroyed by collisions with tiny meteoroids, but a great many eventually fall into the giant planet.

The fact that Jupiter's rings must be continuously furnished with fresh particles led one team of scientists to propose that the rings are "resupplied from sources well outside Roche's limit." This limit, at 2.44 Jovian radii, is the greatest distance at which a hypothetical moon made of water would be disrupted by the tidal force of Jupiter. Why that particular distance has any relation to the problem at hand is unclear. Also, it's hard to understand how particles that are supposedly streaming in from beyond 2.44 Jovian radii to fill the rings are totally invisible beyond the outer ring edge at 1.81 radii.

If new particles don't come from well beyond the rings, perhaps they are generated within the rings themselves. Specifically, they might be tiny fragments con-

Carry 10 times a wheelbarrow load in one easy trip!

The Garden Way® Cart's huge capacity and perfect balance lets you complete tough, heavy chores faster and easier than ever! Wheel-away giant loads — topsoil, mulch, shrubbery, patio or stonewall materials, anything — without tipping, without strain. It's the best outdoor tool you'll ever use. bar none! Find out for yourself. Write today for Free Literature on...

THE INCREDIBLE
Garden Way Cart

3 sizes available

© 1982 Garden Way Inc

Yes! Please send me your FREE Garden Way Cart Literature today

Name

Address

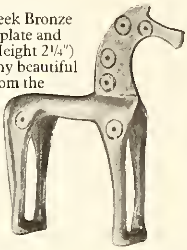
City

State Zip

Garden Way Carts 01
Charlotte, VT 05445 Dept. A1957C

Discover The Museum of Fine Arts, Boston by Mail.

This striking Greek Bronze Horse with gold plate and antique finish (Height 2¼") is just one of many beautiful reproductions from the collections of the renowned Museum of Fine Arts, Boston. Available September 1 through a new 36 page color gift catalogue.



☐ Please send the Greek Bronze Horse. Enclosed is $10.00 (plus $1.50 shipping and handling).

☐ I'd like the Museum catalogue and all others through June, 1984. Enclosed is $1.00.

Name

Street

City

State Zip Code

Mail to:
The Museum of Fine Arts, Boston Shop
Dept. 2H8
P.O. Box 1044 Boston, MA 02120

FROM ERIE
LORRAINE
CHAMPAIGNE
ARGONNE

If This Old Box Could Talk...

"Back then, there were legions of us. In the early 1900's it was. We carried fresh hot bread from bakeries all over America.

As the sun came up, merchants broke our seals, lifted our tops, and displayed hastily scribbled signs: OVEN FRESH BREAD! 5¢ A LOAF.

We were built for a long hard life. With rugged steel corners and wire reinforced sides to protect our delicate cargo.

One of us even went through a war! The first World War as I recall it. Somehow, this particular box found its way to the troop trains holding sandwiches from the Red Cross. It went through battle in France for over a year carrying everything from helmets to hand grenades.

A good lieutenant took a liking to that old box and brought it back to the U.S.A., I'm glad to say, 'cause that old box is me.

Recently, my friends at The Pulley Works admired me so much, they built replicas of me to grace your home. (Shown at right)

Think of it! Chests for firewood, coffee tables and stereo cabinets. They are stained, finished and fill the bill for both beauty and storage, with a trim 28" x 20" x 16" size.

Back then, the company that made me was so impressed with my survival of the war, they made an ad for the bakery trade with my picture. You'll get a reprint of that ad suitable for framing with each bread box.

While you are filling out your check, I'll just rest a bit. Too much activity for a box my age!"

Make check payable to the Pulley Works for $139.00. (freight is included) Wisconsin residents add 5% sales tax.
Send To: The Pulley Works NH
1060 Breezewood Lane, Box 1008, Neenah, WI 54956
Master Card or Visa orders call 1-800-558-5030.
Wisconsin residents call 414-722-2865

NAME

ADDRESS

CITY STATE ZIP

FULL REFUND IF RETURNED WITHIN 30 DAYS

Discover the World with the
AMERICAN MUSEUM OF NATURAL HISTORY IN 1983

You are invited to join renowned Museum experts on custom-designed cruises and land programs to the most fascinating destinations in the world.

Alaskan Wildlife Adventure
Cruise through Scandinavia
Art and Archeology Tours to China and Tibet
Archeology Tour to Mexico
Ancient Maya Archeology
Moroccan Anthropology
Nile Cruise
Indian Ocean Adventure
East African Safaris
Galapagos Islands Cruise
Indonesian Odyssey
Papua New Guinea Tour

INDIAN OCEAN ADVENTURE
January 21 to February 9, 1983

Visit India, Sri Lanka, Burma, Thailand, Malaysia and Singapore on a luxury cruise exclusively designed by the American Museum. Join Dr. Thomas D. Nicholson, Director of the Museum, and a Museum anthropologist, botanist, geologist, and ornithologist for a unique exploration of diverse cultures related by Hindu-Buddhism, and exotic natural habitats. Our luxury ship will be the "Illiria" which is exclusively chartered by the American Museum.

INDONESIAN ODYSSEY
February 3 to 24, 1983

Immediately following our Indian Ocean Adventure, the "Illiria" will sail from Singapore to Java, Lombok, Komodo, Flores, Butung, Sulawesi, and Bali. Share with a Museum anthropologist, geologist, botanist and naturalist an exciting voyage stopping at lush tropical islands with volcanic landscapes to visit fascinating local cultures. Both the Indian Ocean Adventure and this program may be combined for a six-week voyage throughout Southeast Asia.

NILE CRUISE
February 6 to 26, 1983

Explore the astounding ancient sites and natural wonders of Egypt with a Museum geologist, ornithologist and Egyptologist. Cruise 600 miles on the Nile from Cairo to Assuan aboard the custom-built, air-conditioned "Nile Star" stopping at all the important sites which have intrigued visitors for 4000 years.

GALAPAGOS ISLANDS CRUISE
June of 1983

Discover a special natural world with fantastically tame and exotic animals such as sea lions, giant tortoises, marine and land iguanas and countless rare and beautiful birds. Enjoy the expertise of a Museum ornithologist and geologist as we cruise through this equatorial archipelago which so influenced Darwin. Excursions in highland Ecuador are included in the tour, and an optional extension to Peru's archeological sites is scheduled.

CRUISE THROUGH SCANDINAVIA
July 28 to August 15, 1983

The Museum announces its first cruise through the North and Baltic Seas. Visits will be made to Bergen, Flamm, Gudvangen, Oslo, Copenhagen, Oland, Visby, Stora Karlso, Stockholm, Tallinn, Helsinki and Leningrad, in an extraordinarily comprehensive Scandinavian cruise. Join our expert lecturers on this rich cultural and natural history program aboard the luxury ship "Illiria."

LAND PROGRAMS

Ten outstanding overland itineraries have been custom-designed for small groups of 15 to 25 participants. China...Alaska...Tibet...Mexico...East Africa...Papua New Guinea...Famous and remote sites and cultures are discovered while staying at the finest accommodations available with distinguished Museum lecturers.

For further information write or call:

American
Museum of
Natural
History

Discovery Tours

Central Park West at 79th Street
New York, New York 10024
Telephone (212) 873-1440

stantly being chipped off larger objects in the rings, as Jewitt and Danielson of CalTech, and other scientists, have proposed. These larger objects are Burns's mooms, referred to earlier. According to Burns, they include the unseen bodies that produce the radiation blockage reported by Acuna and Ness of Goddard Space Flight Center. The tiny ring particles cannot account for the blockage, since high-energy protons in the Van Allen belts will zip through a rock particle like hot knives through butter. Larger rocks, inches or more in size, are required. A moom can range, then, from a pebble to a small but recognizable full-fledged moon several tens of miles in diameter. (We know for sure that there are no big moons with diameters of 100 miles or more in the rings, since they would readily be seen.)

Assuming that there are mooms in the Jovian rings, what chips away at them to create fresh ring particles? Collisions among the mooms themselves, or among mooms and existing ring particles, are not the answer because adjacent mooms and particles are orbiting in the rings at nearly the same speed and in the same direction. If they were to collide it would be gently. Effective projectiles would have to be particles falling toward the mooms at higher speeds. One high-speed projectile (even if tiny) could, in collision, blast many ring particles off the surface of a moom.

An intriguing idea about the source of the projectiles was advanced by a team of West German and American scientists. Referring to the active volcanoes on the Jovian moon Io (see "Far-out Erupting Volcanoes," *Natural History*, September 1980), these investigators suggested that particles of volcanic ash are electrified in the high-altitude plumes above the volcanoes and are then swept in toward the rings by electromagnetic force. In the rings, the proposal continues, the ash strikes mooms at high speed, thus producing the ring particles. This theory, however, may be destined for the ashcan, since the tiny ash particles are susceptible to sputtering and might be destroyed by that process before they could reach the rings.

A remaining suggestion about the projectiles seems like the best idea. In this view, the projectiles are microscopically small meteoroids, or micrometeoroids, which are known to pervade the solar system to the extent that it has been explored. Space probe measurements show that there are many high-speed micrometeoroids zipping past Jupiter. Striking the mooms, they would blast out tiny craters and dislodge quantities of particles to feed the rings.

Two small moons, which presumably also qualify as mooms, were found in the ring system subsequent to its discovery. One moon, called 1979J1, was spotted in *Voyager 2* photos by Jewitt, Danielson, and Stephen P. Synnott, a navigation engineer at the Jet Propulsion Laboratory. About twenty miles in diameter, this moon circles Jupiter at 1.81 Jovian radii and is capable of producing the sharp outer edge of the bright ring by its gravitational force. The other little moon, 1979J3, was found by Synnott at 1.79 Jovian radii, exactly where the bright ring happens to be brightest. The coincidence of the moon's orbit with the brightening in the ring might be evidence that fresh material is breaking off the surface of 1979J3, as proposed by the mooms theory for the continuing supply of ring particles.

In summary, astronomers now believe that ring particles are blasted off mooms by micrometeoroids. Due to drag, the largest of the particles slowly spiral in toward Jupiter. The smaller particles are destroyed by sputtering before they reach the planet. Before sputtering wipes them out, the very smallest particles become electrically charged and are lifted out of the rings, forming the faint halo. These concepts can be tested when the advanced *Galileo* probe is launched toward Jupiter, probably in 1985.

Recently, I spent a week at the Palomar Observatory in southern California, observing nebulae and comets with Danielson and Jewitt of CalTech. On a dark night when the air was still, we had a superb view of Jupiter through a large telescope. Although the rings have now been detected from the earth with sensitive electronic instruments, we could not see them. Studies continue, nevertheless. On a rainy day later in the week, Danielson reached into a briefcase and pulled out the latest results of his computer processing of the *Voyager 2* photos. To my astonishment, the newly processed images showed that the bright ring is composed of many smaller ringlets, further features that new theories must explain.

When I left Mount Palomar, the California astronomers were preparing to search with the great 200-inch telescope for small moons that *Voyager 2* (which photographed only two-thirds of the rings) may have missed and which may be mooms as previously defined. Flying home to Maryland on a DC 10, I began to wonder what further marvels *Galileo* will find amidst the rings of Jupiter.

Stephen P. Maran is a senior staff scientist in the Laboratory for Astronomy and Solar Physics at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

Share the Thrills of Exploring Outer Space!

$359.95 f.o.b. Hartford, Conn.

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE — the same instruments used by more than 150 schools, colleges and observatories — and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

Criterion Manufacturing Co.
620 Oakwood Ave., W. Hartford, Conn. 06110
® TM Registered U.S. Pat. Office

CRITERION, MANUFACTURING CO., Dept. NH 117
620 Oakwood Avenue, W. Hartford, Conn. 06110
Please send your free Telescope Guide.
Name__________
Address__________
City__________ State__________

Moving

Please give us 8 weeks notice. Attach your label and print your new address below.

NATURAL HISTORY
P.O. Box 4300, Bergenfield, N.J. 07621

PLEASE PRINT
Name__________
New Address__________
City__________ State__________ Zip__________

PLEASE ATTACH MAILING LABEL
Name__________
Address__________
City__________ State__________ Zip__________

Quarrying the Museum

On a recent tour of the American Museum of Natural History with Sidney Horenstein, of the Department of Invertebrates, we spent more time peering at marble walls, limestone wainscoting, stone staircases, and granite escutcheons than at the exhibits themselves. In the Roosevelt Rotunda, for example, Horenstein pointed out 100-million-year-old clams in a decorative limestone from Portugal. The yellowish pillars in the Birds of the World Hall were quarried from a 365-million-year-old fossilized coral reef in Missouri. In the limestone lining the grand staircases, Horenstein discovered delicate, spiraled fossils of snails. And in the reddish marble separating the toilet stalls in a fifth-floor men's room, we glimpsed 475-million-year-old fossil bryozoans through a magnifying glass.

But the oldest stone in the Museum buildings, according to Horenstein, is the reddish granite used to construct the magnificent Romanesque revival façade along 77th Street. The façade was built over a twenty-year period at the turn of the century, and successive builders went to great lengths to match the distinctive pink shade of the stone. They found the right stone in various places in Maine, New York State, New Hampshire, Connecticut, and New Brunswick, Canada.

Several years ago, Horenstein decided to visit every quarry from which the Museum's exterior building stones were excavated. He looked up the original plans of the Museum buildings and combed old newspapers, nineteenth-century architectural journals, and geology papers. He discovered that much of the granite used to build the 77th Street façade came from the Canadian Shield, a vast geologic formation underlying much of Canada and parts of the Northeast. Formed more than a billion years ago in a molten complex deep in the earth's crust, the rock, through successive stages of erosion and uplift, was gradually exposed at various parts of the surface. Its pink color is caused by a preponderance of the mineral feldspar.

Horenstein carries on most of his research in a cluttered office on the fifth floor of the Museum. Geologic maps with interlocking bands of color hang on the walls, next to geologic time charts and overflowing bookcases. Littering several tables in the room are stacks of well-thumbed journals, papers, cardboard trays of fossils, jars filled with shark teeth, plastic bags of sand, several microscopes, and a number of polished, sectioned slabs of stone. These slabs are part of Horenstein's building-stone collection, which he has gathered during years of researching the stones used to construct the city's buildings. His knowledge is so detailed that he can reel off the 400-million-year history of the limestone façade of a seedy bar on 72nd Street, or show you fossil goniatite cephalopods in the marble lobby of an East Side high-rise.

But Horenstein's favorite and most thoroughly researched building is the Museum itself, and he has visited almost one hundred quarries since he embarked on his project. Most of them are in remote locations and have been deserted for half a century or more. "I remember one trip I made," said Horenstein, "to a quarry on the Canadian border. I had come across a reference in a nineteenth-century architecture journal about a 'new wing' being built at the American Museum. According to the article, the granite was being quarried on Picton Island in the Thousand Islands area of the Saint Lawrence River. I wanted to see this quarry, so when I was on vacation with my family in the region, I spent some time in a town called Clayton, on the Saint Lawrence. I talked to the local historians and dug through old files in the library, and one of my contacts told me that Picton Island was owned by a Bernard Heineman, who was somewhat of a recluse. People tried to discourage me from calling him—they said he 'wasn't much on meeting people'—but I called him anyway and explained my project. To my surprise he invited me to the island for the day, on the condition that I would play backgammon with him.

"A huge classic wooden speedboat met me at the dock. After the backgammon games, which I lost, Heineman, who was quite old, showed me around the island. He had laid out miles of trails through the woods, and he would drive around in a little motorized cart looking at birds. He was an avid butterfly collector and had the best collection in the world of Jamaican butterflies. It turned out that over the years this fellow had given the Museum thousands of rare butterflies from all over the world, including specimens from Picton Island. He had even written a book about Jamaican butterflies with a research associate at the Museum. And yet, he had no idea that the stone for a good portion of the Museum had been taken right out of his backyard a century ago."

Horenstein also visited Deer Island, off the Maine coast near Acadia National Park, which had provided the stone for the sweeping steps of the Museum's 77th Street entrance. "This Deer Island granite was once a very popular stone," he said. "It was used to build the base of Rockefeller Center and many other New York buildings. When I saw it, the quarry had been deserted for years and was just a hole in the ground surrounded by decaying hoists. But granite is coming back in vogue as it is an excellent insulator, and I understand they have plans for reopening the Deer Island quarry.

"Quarries are almost always out in the middle of nowhere, which is one reason why I like to search them out. I used to have trouble locating quarries because the maps are bad and the roads are overgrown or washed out. One time, in the Adirondacks, I was having a terrible time trying to find a quarry that had provided stone for the Roosevelt Memorial building. I stopped a group of kids and asked where the quarry was, and they said there *was* no quarry. Then I had an idea. I asked them where the swimming pits were. Sure enough, there was my quarry. Now when I can't find a quarry I just look for a bunch of kids."

Douglas J. Preston

Summer Safari

Because of its thick trunk and irregular branches, the baobab tree is known in African legends as "the tree that was planted upside down." Although the baobab is not exceptionally tall, its trunk can reach up to 130 feet in circumference. The baobab is crucial to the cycle of life in areas of Africa, and its trunk and branches form a microenvironment for insects, birds, reptiles, and mammals. A two-part film, *Baobab: Portrait of a Tree,* will be shown on Wednesday, August 11, at 6:00 and again at 7:30 p.m. in the Auditorium. The program is free for members, and $2.00 for nonmembers.

Confiscated!

An exhibition of items that have been confiscated by U.S. Customs officials is currently on display in the Hall of Oceanic Birds. *Confiscated* looks at the international traffic in contraband furs, skins, ivory, and other products from rare or endangered animals. The exhibit includes leopard-skin coats, whale teeth, crocodile-skin shoes and accessories, and other illegal items. The intent of the exhibit is to educate people about the grave threat to wildlife caused by poaching and illicit traffic in animal products. The exhibit will run through October.

Wanderers in the Night

A new Sky Show at the Hayden Planetarium explores the story of humanity's fascination with the planets. Beginning with the theory that the earth was the center of the universe and the planets were gods, *Wanderers in the Night* explores Galileo's first probing of the heavens with a primitive telescope, Newton's grand unification of earthly and celestial mechanics, and Kepler's startling theory that the planets do not orbit in circles, to the most recent discoveries using spacecraft and giant telescopes. Special effects in the show include representations of fierce volcanic activity on Jupiter's moon Io, raging storms on the 600° surface of Venus, and the perpetual night of Pluto. *Wanderers in the Night* opens on Thursday, August 5, and runs through September 6. Please call the Planetarium for Sky Show times.

For more information about programs listed in this section, call the appropriate department: Education Department (212) 873-1300; Membership Department 873-1327; Hayden Planetarium 873-1300. Or write to the department at the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024.

The Museum's Naturemax Theater will be showing a new IMAX film, Hail Columbia!, *a giant-screen motion picture chronicling the world's first space shuttle flight. Included in the spectacular footage is the launch sequence, filmed at the Kennedy Space Center by remote-controlled cameras located just over 1,000 feet from the shuttle—at least twelve times closer than the nearest public spectator.* Hail Columbia! *is being shown daily in the Naturemax Theater and will alternate on weekdays with the film* To Fly. *For information on ticket prices and show times, call (212) 496-0900.*

Carl Esch Photographic Services

The World 'n General

GENERAL TOURS

TAKES YOU TO

EGYPT

ECONOMICALLY!

9–17 Days from $1437*

includes Air Fare

THE ONLY WAY TO GO...
THE RIGHT PRICES...
THE RIGHT WAY...
THE
GENERAL TOURS
WAY!

Tour Features Include:
- First Class 4 or 7 Day Nile Cruises
- Deluxe Hotels throughout
- American Tour Manager

*All prices per person double occupancy from N.Y. Single supplements available

ASTA American Society of Travel Agents USTOA

Member of the First Family of Travel

What A Way To Go!

GENERAL TOURS, INC.
711 THIRD AVE.
NY,NY 10017
212-687-7400 NH 8/82

YES! I want to see Egypt.
Please send: my free copy of
THE EGYPT BOOK

name ______
address ______
______ zip ______
my travel agent: ______
______

THE MARKET

Art

AMERICAN INDIAN CRAFTS: Southwest Indian pottery, baskets, rugs, kachinas. Northwest Coast Indian masks, totems, graphics, Eskimo sculpture. Recent African bronzes. No catalogue. One-of-a-kind pieces, individually photographed. Priced $100/up. Photos and data available. Specify interests. Box 5896, Sherman Oaks, CA 91413. (213) 789-2559

MASKS FROM INDONESIA, assorted styles, wood, painted, $30—$90, request photos, McCoy Imports, Liberty, NY 12754

Back Numbers

NATIONAL GEOGRAPHICS 1888-1982, issues Book Publications, Collectors Items, Send Wants Buxbaum Geographics, Box 465-NH, Wilmington, DE 19899

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHT, 84 Fifth Avenue, New York, NY 10011

Books

BOOKFINDING LIBRARIANS locate any subject or title, 150,000 different titles in stock, indexed by author, subject & title. PAB, 2918 Atlantic Avenue, Atlantic City, NJ 08401 or (609) 344-1943

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalogue: Hamilton's, 98-55 Clapboard, Danbury, CT 06810

TRAVEL, ADVENTURE, AND EXPLORATION books. The usual and the unusual. Free catalogue from The Armchair Exlorer, Dept. NH, 333 Bellam Blvd., San Rafael, CA 94901

Correspondence

SINGLE BOOKLOVERS gets cultured persons acquainted. Nationwide. Established 1970. Write Box AE, Swarthmore, PA 19081 or call (215) 566-2132

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin, West Germany

PENFRIENDS-ENGLAND-USA. Make lasting friendships through correspondence. Send age, interests. Free reply. Harmony, Box 89NH, Brooklyn, NY 11235

SCANDINAVIAN LADIES, sincere, seek correspondence for meaningful relationships. Details: Scannaclub, Dept. H6, Box 4, Pittsford, NY 14534

Education

FIELD COURSES IN NATURAL HISTORY. College credit. Write Aspen Center for Environmental Studies, Box 8777A, Aspen, CO 81612

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest Handbook, $2.00 (guaranteed). Australian International, Box 19107-RV, Washington, DC 20036

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RV, Washington, DC 20036

OVERSEAS JOB—68 COUNTRIES! Hiring now! Paid fare. Computerized reports $2.00. Jobworld, Box 681-NH, Cypress, CA 90630

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . . Intermountain 4Y, 3506 Birch, Cheyenne, WY 82001

TEACH HERE—TEACH ABROAD: School, College openings; USA $5.95; Abroad $5.95. Placement sources: USA $4.95; Abroad $4.95. EISF, Box 662, Newton, Massachusetts 02162

Financial

GET CASH GRANTS—FROM GOVERNMENT. (Never repay). Also, cash loans available. All ages eligible. Complete information, $2 (refundable). Surplus Funds-NH, 1629 K St., Washington, DC 20006

Gourmet Interests

BBQ TIME! Tired of tomato based sauces and marinades? Send $2 and SASE for eight recipes, KRJ, P.O. Box 3748, Stateline, NV 89449

Government Surplus

GOVERNMENT SURPLUS! Millions of items (Including Jeeps) . . . low as 1¢ on dollar! Most complete Directory available—$2.00. Disposal, Box 19107-RV, Washington, DC 20036

JEEPS, CARS, pickups from $35. Available at local Government Auctions. For Directory call (805) 687-6000 Extension 910. Call refundable.

Merchandise/Gifts

CAMPER'S KNIFE features stainless steel knife, fork, spoon and bottle/can opener. Weighs 2½ ounces. Send $9.98 + $2.00 Shipping to Townhouse Designs, Dept. CKT1, Box 3248, Brooklyn, NY 11202

IDENTIFY YOURSELF with Indian Hand made silver w/turquoise Lapel Name Tags and/or Sand Painting Desk Plaques in several sizes and styles. For free brochure write: Custom Enterprises, Dept. N2-Box 2997, Gallup, NM 87301

WINDBELLS GUARANTEED 350 YEARS—Crystal clear, resonant tones cast of indestructible Bronze. 20", 1¼ lb. windbell $22 postpaid. Free brochure describes 39 unique handmade designs. Harmony Hollow Bellworks, Box 1303, Ann Arbor, MI 48106-1303

YOUR NAME PERMANENTLY ENGRAVED in script on 4½" gold satin finish brass plate. Satisfaction guaranteed. $5.50. Send check or money order to: Top Brass Engravers, 4419 Market Street, Youngstown, Ohio 44512

Music

RECORDS-TAPES! Discounts to 73%. All labels; no purchase obligations; newsletter; discount dividend certificates. 100% guarantees. Free details. Discount Music Club, 650 Main Street, P.O. Box 2000, Dept. 25-0882, New Rochelle, NY 10801

Optical

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON. Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired. Large stock. Orders filled postpaid day received. Birding, Box 5N, Amsterdam, NY 12010

OPTIC DISCOUNTS: Binoculars—Telescopes—Brand Names—Free List. Thos. Manetta, Box 12, 61 Hoffman Ave., Elmont, NY 11003

Personals

MEET SINGLES Mexico, Orient, Europe, Australia. Free information. Write: International, Box 1716-NH, Chula Vista, CA 92012

Real Estate

FREE CATALOGUE. Describes and pictures farms, ranches, acreages, businesses and town and country homes from coast to coast. UNITED FARM AGENCY, INC., 612-U W. 47th St., Kansas City MO 64112. Call Toll-Free: 1-800-821-2599; MO res. call Toll-Free: 1-800-892-5785

GOVERNMENT LANDS . . . FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00. Lands, Box 19107-RV, Washington, DC 20036

NEW! FREE! BIG Fall-Holiday Catalogue! Over 5,400 country properties described, pictured! Land, farms, homes, businesses, recreation, retirement values! Selected best of hundreds of offices All Across America! Strout Realty, Inc., Executive Park Tower, Dept. 5390, Albany, NY 12203. Call toll free: 1-800-641-4266; in Missouri call collect (417) 862-4402

Resorts

TOBAGO, PRIVATE BEACH COTTAGES on working cocoa plantation. Swimming, snorkeling, fishing from your front door. Bird watcher's paradise. Brochure. Charles A. Turpin, Charlotteville, Tobago, West Indies

Market in Cuenca, Ecuador

Rolf Blomberg

NATURAL HISTORY MAGAZINE

SAVINGS CERTIFICATE

For FOR THE SUM OF 9 DOLLARS

This savings certificate saves you $9.00 off the single copy rate for 1 year on new subscriptions or renewals (12 beautiful and thought-provoking issues) of NATURAL HISTORY magazine, including membership in the American Museum of Natural History and all the benefits that go with it. As soon as we receive your order, we'll start your subscription and send your membership card.

☐ **YES,** Please send me a full year of Natural History at the low rate of $15 for 12 issues including Museum membership

☐ I want to save more. Send me 2 years of Natural History (24 issues) which includes membership for only $26 (a $22 savings off the single copy price).

☐ New ☐ Renewal

Name ______ (please print)
Address ______
City ______
State ______ Zip ______

☐ Payment enclosed ☐ Bill me later
Charge my ☐ Visa ☐ MasterCard
☐ American Express

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
Account number

Send gift to: J556

Name ______ (please print)
Address ______
City ______
State ______ Zip ______

Gift card to read ______ ☐ 1 year $15 ☐ 2 years $26

Signature ______

Moneyback guarantee if not satisfied.

Please add $5 per year for postage outside the USA. Payment must be included.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

POSTAGE WILL BE PAID BY ADDRESSEE

NATURAL HISTORY

P.O. Box 4200
Bergenfield, N.J. 07621

Tours/Trips

AFRICAN WILDLIFE SAFARIS. Kenya, Tanzania, Rwanda Small groups guided by expert naturalists. Summer, 1982 and Winter, 1983. Special departures organized for college and university groups. Write for free catalog. Wilderness Travel, 1760-AF Solano Avenue, Berkeley, CA 94707

AFROTROPICAL ECOSYSTEMS SAFARI! A unique tour including all major African habitats (including coral reefs). This 38 day safari can be split: Namibia, South-western Cape, Botswana, Zimbabwe with optional Malawi extension (22 days) or Kenya, Cameroon, Senegal with Malawi option (22 days). Departs late October 1982. Lead by African specialists Dr Jim Hitchcock and Dr. Rolf Jensen. Safari expectations: 1,000 Birds and virtually all larger Mammals Write Now! Ecological Study Groups, Box 1288, Nevada City, CA 95959

ALASKAN WATER ADVENTURES. Kayaking, Rafting, Birding in Prince William Sound and Copper River Basin. College credit available. Open Door. Box 1185N, Cordova, Alaska 99574 (907) 424-7466

DISCOVER BAJA! Join experienced naturalists and crew for leisurely ocean-going explorations of the wilderness islands and lagoons of Baja's Pacific coast, the Sea of Cortez, or Mexico's tropical west coast. Enjoy whales, seals, dolphin, birding, fishing, nature study, island hiking, and more! Excellent photo opportunities. Small groups, relaxed pace. Trips 4-10 days year-round for individuals or groups Color brochure: Pacific Adventures Charter Service, 2445 Morena Blvd., Suite 200H, San Diego, CA 92110 (714) 275-4253

Unusual India & Nepal

Trekking (walking) expeditions to the foot of Mt. Everest & Annapurna Wildlife safaris in search of rare Asian birds and mammals Explorations of remote Bhutan, Sikkim, Ladakh and tropical Sri Lanka. 10 to 35 day programs from $670.00 + airfare Free Brochures

Himalayan Travel, Inc.
P.O. Box 481-NH
Greenwich, CT 06830
(203) 622-0055 Toll Free (800) 243-5330

EXPLORE THE SEA OF CORTEZ with Scripps Aquarium Oct. 17-23, 1982. Dive and collect Mexican marine life for exhibits and research. Scuba certificates required for divers. Scripps Aquarium-Museum A-007, La Jolla, CA 92093

GALAPAGOS ISLANDS. Economic tours from $1638, including airfare. 4, 5, 8, & 15 days Galapagos, all meals. Options, mainland Ecuador, Amazon, Cuzco/Machu Picchu. University credit available. Joseph Colley, Last, Inc., 43 Millstone Rd., Randallstown, MD 21133. (301) 922-3116

LEGENDARY CULTURES, FASCINATING NATURE: Special Travel to Latin America, Africa, Asia. Groups/Individuals. Forum Travel, 2437 Durant, Berkeley, California 94704 (415) 843-8294

NEW ZEALAND WALKABOUT: Escorted nature and hiking tours featuring New Zealand's scenic National Parks, plus the Milford Track. Pacific Exploration Co., Box 3042-N, Santa Barbara, California 93105 (805) 687-7282

WHALE SIGHTING, CAPE COD, September 14-16, $150.00. Cetacean Research, Oak Ridge, NJ 07438 (201) 697-7233

RATES AND STYLE INFORMATION

$1.75 per word; 16 word ($28) minimum. *Display classified* is $150 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY to: The Market, NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024. Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—1st of the month, two months prior to cover date (the January issue closes Nov. 1). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

BLACK ONYX & CRYSTAL

A. Black onyx necklace, with crystal fan pendant, gold filled rondels, 16", $95.00. **B.** Black onyx and crystal earrings, gold filled ear wire, $42.00. **C.** Bracelet. Two rows of onyx and crystal beads, gold filled rondels, $67.00.

Members are entitled to a 10% discount. Please add $2 shipping and handling for each item ordered. Add N.Y. sales tax where applicable.

Detach here

Museum Shop
American Museum of
Natural History
Central Park West at 79th Street
N.Y., N.Y. 10024

Please send me:
____ Necklace(s)
____ Earrings(s)
____ Bracelet(s)

I enclose a check payable to the American Museum of Natural History for

$________

Charge to:

☐ MasterCharge ☐ Visa

Account #

Expiration Date

Signature (required if using credit card)

Name

Address

City State Zip

Curator, the prestigious scholarly journal published for 25 years by the American Museum of Natural History in New York.

If you are a museum professional facing the problems most museum professionals are facing, then you should be reading **Curator**.

Curator covers all aspects of museums ...the booming use of computers ...creative fund raising...collections management...non-profit publishing ...innovative design ideas...new educational programs...exhibit evaluation...museums and direct mail...income generating programs... and much more.

Invaluable reading for the *creative* museum professional.

CURATOR

To order your subscription to **Curator**, please use this coupon:

☐ 1 year (four issues) $15
☐ 2 years $26
☐ 3 years $35
Foreign subscriptions please add $3 per year postage.

☐ Payment enclosed ☐ Bill me

Name
Address
City State Zip

Please make check payable to the American Museum of Natural History and mail to: Curator subscriptions, American Museum of Natural History, Central Park West at 79th Street, New York, NY 10024. All subscriptions start with the first issue in a volume.

Better Than Jogging

NordicTrack

Jarless Total Body Cardiovascular Exerciser
Duplicates X-C Skiing for the Best Motion in Fitness

Highly Effective and Pleasant To Use
The enjoyable sport of cross-country skiing is often cited by physiologists as the most perfect form of cardiovascular exercise for both men and women. Its smooth, fluid, total body motion uniformly exercises more muscles and higher heart rates seem easier to attain than when jogging or cycling. NordicTrack closely simulates the pleasant X-C skiing motion and provides the same cardiovascular endurance-building benefits — right in the convenience of your home. Makes a year round, consistent exercise program easily attainable. Eliminates the usual barriers of time, weather, chance of injury, etc. Also highly effective for weight control.

Better Than Running
NordicTrack gives you a more complete work out — conditions both upper body and lower body muscles at the same time. Fluid, jarless motion will not cause joint or back pains as jogging or running often does.

Better Than Exercise Bikes
NordicTrack's stand-up skiing motion more uniformly exercises large leg muscles and also adds important upper body exercise. Higher pulse rates, necessary for building fitness, seem easier to attain because the work is shared by more muscle mass. The NordicTrack also keeps more muscles in tone.

Even Better Than Swimming
NordicTrack more effectively exercises the largest muscles in the body, those located in the legs and buttocks. These muscles' main function is to lift and propel the body in the standing position. However, when swimming, the body is supported by the water, thus preventing these muscles from being effectively exercised. The stand up exercising position on the NordicTrack very effectively exercises these muscles.

A Proven, High Quality Durable Product
Ruggedly constructed, NordicTrack is quiet, motorless and folds compactly for storage. Separately adjustable arm and leg resistances. NordicTrack is in its 5th year of production and is used in thousands of homes and many companies. We manufacture and sell direct. Our No-Risk 15 day trial guarantee shows our confidence in your being pleased with the performance and quality of the NordicTrack.

For more information, call or write
PSI 124 L Columbia ct. Chaska, MN 55318
toll free 1-800-328-5888 8 – 5 Mon – Fri
Minnesota 612-448-6987

Celestial Events

by Thomas D. Nicholson

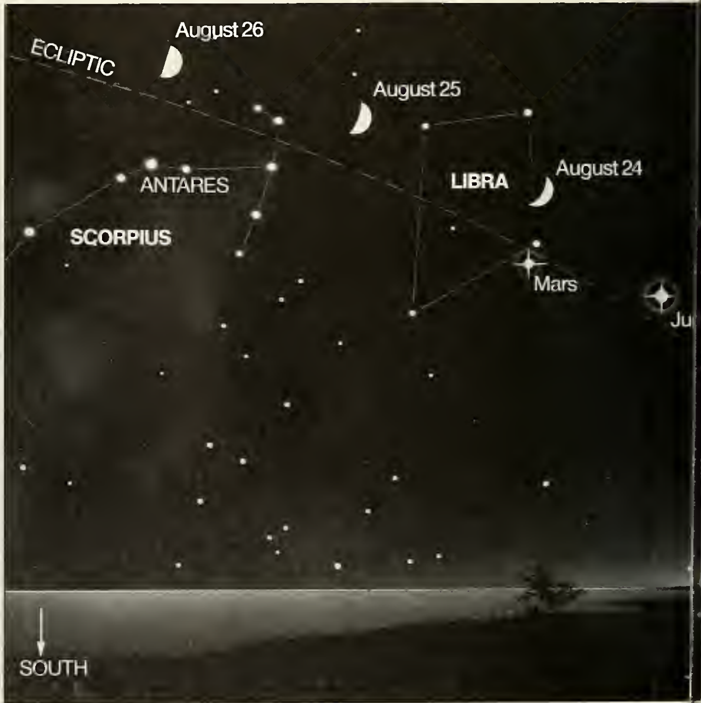
All Month Jupiter is the brightest evening star this month, easily seen each clear night in the southwest from dusk until it sets several hours later. Its two planet companions of this summer, Saturn and Mars, are still with it, but the fine display the trio have been putting on since last winter is just about coming to an end. The culprit in closing the drama is Mars. Now well past the opposition that made it so bright and prominent last March, Mars is separating rapidly from the earth, causing it to grow dimmer and to move swiftly eastward through the stars. In August Mars moves through Virgo and Libra, past Saturn, Spica, and Jupiter. At the end of the month, it is moving swiftly away from Jupiter toward the star Spica, in Virgo.

Venus is seen best as a morning star this month during the current cycle of its configurations, although this is not a good morning elongation even now. Still, you should be able to see it any clear morning from dawn until it fades into the brightening daylight, low in the east.

August is Perseid meteor shower month, the best meteor show of the year. If you haven't tried meteor watching yet, this is the one to begin with. Best dates are 11, 12, 13, and 14, from about 1:00 A.M. until dawn. You can probably see from thirty to fifty meteors per hour during these mornings, many of them very bright, popping and flashing as they streak across the sky. Light from the waning moon will limit viewing of fainter objects. Choose a viewing location away from lights, without trees or buildings to hide the sky. Sit or lie in a lounging chair, scanning slowly through as much of the sky as you can, paying attention to peripheral vision. Don't concentrate on Perseus. Although the radiant of the stream is in that direction, meteors will appear everywhere.

August 1: The waning gibbous moon tonight is at apogee, most distant from the earth. Look below the moon for the stars of Sagittarius, arranged as a "teapot," with the moon just above the "lid."

August 4: The full moon is in Capri-



Helmut Wimmer

cornus. The clue to this constellation is a group of dim stars arranged in the form of bikini shorts, but the brightness of the moon makes it difficult to see them.

August 7: The waning moon rises almost two hours after sunset. About midnight, look above the moon for the Square of Pegasus, then down along its sides past the moon to the bright stars Fomalhaut (to the right) and Diphda (to the left).

August 9: Mars overtakes Jupiter tonight, moving from right to left past the brighter planet. Only a month ago, Mars was to the right (west) of Saturn, Spica, and Jupiter in the evening sky. Now, much dimmer than it was last spring, it is to their left (east), moving rapidly away.

August 10–11: Venus, very bright and low in the east at dawn, is virtually in line with Castor and Pollux (the "twin" stars of Gemini).

August 12: Last-quarter moon, with the dim stars of the Pleiades (Seven Sisters) above it. The reliable and productive Perseid meteor shower (fifty or more per hour) is at maximum today. Moonlight will interfere, especially toward morning as the moon rises higher, but the brighter meteors, for which this shower is noted, should make easy hunting.

August 17: The perigee moon (nearest the earth) is close to Venus at dawn.

August 18: New moon.

August 21: The young crescent moon should be clearly visible tonight low in the west during twilight. As darkness deepens, look to its left, where Saturn, Jupiter, and Mars curve up the sky along the earth's orbital plane, with the bright star Spica between Saturn and Jupiter.

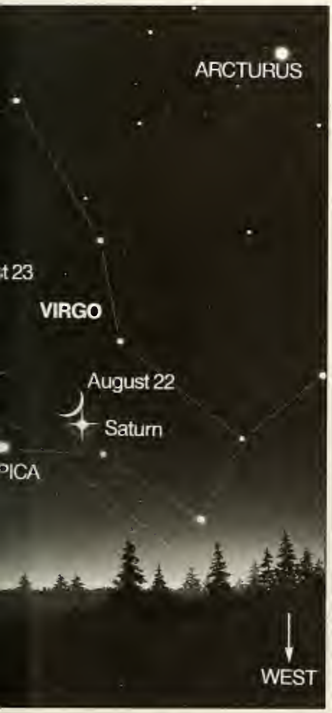
August 22: The moon is between Saturn and Spica tonight.

August 23: The moon passes south of Jupiter tonight, then below Mars during the day on the 24th.

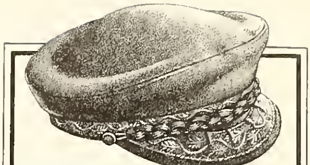
August 25: The first-quarter moon is in Scorpius. The reddish star below the moon is Antares. The moon is closer to Scorpius, above to its left on the night of the 26th.

August 28–31: The waxing moon is again in Sagittarius on the 28th, at apogee on the 29th, and in Capricornus on the 30th and 31st.

Editor's Note: The Sky Map in the July issue shows the evening constellations and stars for this month and gives the times for use.



This year's planet convention in the evening sky (Mars, Jupiter, and Saturn) offers an interesting "last hurrah" before breaking up at the end of August. Shown here is the early evening sky shortly after sundown on August 25, when six bright objects trace out the course of the zodiac and the ecliptic (marking the earth's orbital plane). From right to left, beginning in the evening twilight glow and curving upward into the south and southeast, the objects are Saturn, Spica (the bright star in Virgo), Jupiter, Mars, the moon, and Antares (the brightest star in Scorpius). Except for brilliant Jupiter and the moon, all the other objects are of about the same brightness. Note how they cluster within the constellations of the zodiac, never far from the plane of the earth's orbit, which projects on the sky as the ecliptic.



GREEK FISHERMAN'S CAP The traditional headgear of Greek fishermen and a favorite of pleasure-craft sailors. Fully lined wool/nylon fabric stands up to sea spray and sun. Richly embroidered in Mediterranean style. **Sizes:** 6¾-7¾. **Colors:** Black, Brown or Gray. **$13.95** postpaid.

Order Today! Money Back Guarantee!

Here is my check or money order for $______
(Add sales tax for shipment into CA, CO, D.C., IL, MI, PA, WA).
RUSH my **#1984 Greek Fisherman's Cap**
Size ______ Color ______
Name ______
Address ______
City ______
State ______ Zip ______
☐ **Send me your FREE color catalog of quality outdoor apparel and equipment.**

Eddie Bauer®

Dept. CNH, Fifth & Union, Seattle, WA 98124

LEARN PROFESSIONAL
PHOTOGRAPHY
at home.

Would you like to see your pictures in magazines like this? For 70 years, NYI has trained amateurs to take professional pictures — pictures that get published, win prizes, even lead to a new career. If you love photography, NYI can make it happen for you too.

You'll learn at home in your spare time, with our new "Voice-on-Tape" method that guides you easily through magnificent portfolio-size lessons, illustrated by salon-quality photos of world-famous masters. A remarkable course at surprisingly low cost. Call or send for free informative booklet. No obligation.

Mail coupon OR CALL TOLL FREE 800-453-9000

Yes! Send me the free color booklet about the NYI Course. No obligation. No salesman will call.
Name ______
Address ______
City/State/Zip ______
☐ Under 18, check here for special information.
New York Institute of Photography
Dept. N82 880 Third Ave., N.Y., N.Y. 10022

Additional Reading

Tree Shrews (p. 26)

The inclusion of the tree shrews in the order Primates has been debated by scientists throughout the years. W.E. Le Gros Clark, in his *Antecedents of Man* (Chicago: Quadrangle Books, 1971, third edition), an introduction to the evolution of the primates, discusses the controversy in the subchapter "The Affinities of Tree-Shrews" (pp. 317–23). Briefly pointing to anatomical, paleontological, and other evidence, he maintains that the tree shrews should be considered primates and refutes specific contentions to the contrary. He adopts the view that tree shrews "should still be regarded as extremely primitive members of the order Primates that branched off very early from the basal primate stock . . . and that . . . they have developed some aberrant specializations peculiar to themselves" and concludes that "the lowliest representatives among the living Primates are the tree-shrews." In 1945 Le Gros Clark's position was given important support by G.G. Simpson's authoritative *The Principles of Classification and A Classification of Mammals* (*Bulletin of the American Museum of Natural History*, vol. 85). A.S. Romer's well-known text, *Vertebrate Paleontology* (Chicago: University of Chicago Press, 1966, third edition), also placed the tree shrews with the primates. But in 1980, *Comparative Biology and Evolutionary Relationships of Tree Shrews*, edited by W.P. Luckett (New York: Plenum Publishing Co., 1980), ruled out the possibility of a primate connection. Contributors to the text were asked to evaluate the possible evolutionary relationships of tree shrews to primates and other placental mammals; specifically, they were directed to consider if there are uniquely derived biological attributes shared solely by tupaiids and primates. And if tupaiids are not cladistically primates, what are they most closely related to and how should they be classified? Topics researched include systematics, the tree shrew's cranioskeletal system and dentition, its nervous and reproductive systems, and its molecular evolution. The volume concludes that tree shrews have evolved independently since at least the early Tertiary and should be recognized with a separate ordinal status. *Prosimian Biology*, edited by R.D. Martin, G.A. Doyle, and A.C. Walker (London: Duckworth, 1974), is a broadly based, 983-page volume with specific articles ranging from prosimian behavior to anatomy, biochemistry, and evolution. The book is based on the proceedings of an international meeting at the University of London in 1972 to discuss the general field of prosimian biology. Tree shrews, considered "honorary" prosimians for the purposes of the conference, are included in the book: see F. D'Souza's "A Preliminary Field Report on the Lesser Tree Shrew (*Tupaia minor*)" (pp. 167–82) and D. von Holst's "Social Stress in the Tree-Shrew: Its Causes and Physiological and Ethological Consequences" (pp. 389–411).

Sahabi Fossils (p. 34)

S.L. Washburn and R. Moore's *Ape into Human* (Boston: Little, Brown and Co., 1980) presents up-to-date biological and behavioral material on human evolution. An introductory-level college textbook, it is available in paperback for $6.95. *Missing Links*, by photojournalist J. Reader (Boston: Little, Brown and Co., 1981), is an account of the search for the creature whose place in the evolutionary chain lies between apes and *Homo sapiens*. Using interviews, diaries, letters, newspaper articles, and scholarly reports, the author re-creates the events that led to major paleontological finds in the hunt for early humans. Beginning with the 1857 discovery of Neanderthal man in western Europe, Reader documents the discoveries of Java man, Piltdown man, *Australopithecus africanus*, Peking man, and the Lucy skeleton (*A. afarensis*), up to Mary Leakey's recent find of fossilized hominid footprints that are probably 3.6 million years old. *Fossils in the Making*, by A.K. Behrensmeyer and A.P. Hill (Chicago: University of Chicago Press, 1980), provides a general introduction to the new research fields of vertebrate paleoecology and taphonomy. Comprising fifteen articles, the book tells how paleoecologists and taphonomists deal with problems in the fossil record and also gives information on specific regions, time periods, and fossil localities that have been testing grounds for paleoecological research. *In the Deserts of This Earth*, by U. George, translated from the German by R. and C. Winston (New York: Harcourt Brace Jovanovich, Inc., 1977), begins with a clearly written explanation of the earth's origin and its geologic history, including the formation of the deserts. A filmmaker and naturalist, the author spent sixteen years exploring various deserts throughout the world, examining their terrains and life forms. He describes "ghost rains," flash floods, sand and dust storms, and the animals, such as the sand grouse and the camel, that are able to survive in the desert environment.

Lubéron regional park, France

Martina Franck, Magnum

French Parks (p. 42)

A. and M. MacEwen's book on the national parks of England, *National Parks: Conservation or Cosmetics* (London: George Allen and Unwin, 1981), is aimed at readers interested in understanding different problems of park management, such as conflicts in land use and how to accommodate the demands of various interest groups. It discusses the history of the individual English parks and how they differ from one another. K. Curry-Lindhal and J.-P. Harroy's *National Parks of the World* (New York: Golden Press, 1972) is an official publication of the International Union for Conservation of Nature and Natural Resources. It focuses on the world's large national parks—in Europe, North and South America, Africa, Asia, Australia, and Oceania—and includes many color photographs. More specific accounts discussing the French regional parks include C.L. Moulin's "Plan for Ecological and Cultural Tourism Involving Participation of Local Population and Associations," reprinted in the two-volume *Tourism Planning and Development Issues*, edited by D.E. Hawkins et al. (Washington, D.C.: George Washington University Press, 1980). In "Off the Beaten Path in France" (*The New York Times*, Sunday Travel Section, February 28, 1982, p. 14), J.L. Sax gives a day-by-day report of his visit to three of France's nature parks: the Morvan and the Pilat regional parks and the Vanoise National Park. The article includes much information about the French parks and how to go about visiting them. "Partir en France" (*L'Express*, August 7, 1981, No. 1569, International Edition, p. 48) is another popular article about hiking, backpacking, and camping vacations in France's rural areas. For more information about the French regional parks, write to the Fédération des Parcs Naturels de France, 4 rue de Stockholm, 75008 Paris, or to the specific parks at their headquarters. For information about *gîtes ruraux* and *auberges rurales*, write to La Fédération Française de Camping et de Caravaning, 78 rue de Rivoli, 75004 Paris.

Gray Gulls (p. 52)

R.C. Murphy's classic two-volume work, *Oceanic Birds of South America* (New York: The Macmillan Company and the American Museum of Natural History, 1936), is still the best in its field. Filling more than 1,200 pages and illustrated with paintings, photographs, maps, and drawings, the work is divided into two parts: The Physical Environment, including the geographical background of South America, the hydrology in relation to oceanic birds, and an ornithological circumnavigation of South America; and The Oceanic Birds, which discusses the individual species. Murphy's account of the gray gull was written before there was any published record of its nesting place, but he does cite a story told by an old resident of the Chilean desert that correctly describes the gray gull's nocturnal activities. Murphy, however, was unfamiliar with *garuma*, the local word for the gray gull, and assumed that the story applied to some kind of petrel. M. Moynihan's *Hostile and Sexual Behavior Patterns of South American and Pacific* Laridae (Leiden: E.J. Brill, Behaviour Supplement VIII, 1962) is difficult to find except in university libraries but worth the search for readers interested in gull and tern behavior. Moynihan's ethological interpretations make for difficult reading, but he describes and illustrates just about every kind of reproductive behavior of the gray gull that can be seen on the coast. A.W. Johnson's two-volume *The Birds of Chile and Adjacent Regions of Argentina, Bolivia and Peru* (Buenos Aires: Platt Est. Graf., 1965, 1967) is a reorganization and expansion of *Las Aves de Chile*, which he coauthored with R.A. Philippi and J.D. Goodall. The book, which includes color plates by J.D. Goodall that allow for identification of birds in the field, describes the general characteristics of each family or genus and includes much useful, detailed data. Johnson describes his discovery of a gray gull's nest in the second volume. *The Herring Gull's World*, by Nobel laureate N. Tinbergen with an introduction by K. Lorenz (New York: Harper and Row, 1971), is an interesting, readable introduction to the behavior of the herring gull. Tinbergen's studies on gulls are the basis for all subsequent work on the behavior of *Larus* species.

Rita Campon

Erratum: The photo captions on pages 44–45 and 46–47 of our July 1982 issue were inadvertently transposed.

The World 'n General

GENERAL TOURS

THE AFRICA EXPERTS
TAKES YOU ON A

KENYA

ACTION SAFARI

15 days
from $2336*
including air fare

NOBODY BUT NOBODY beats General Tours lowest prices for deluxe features.

- 9 full days on Safari including all meals
- round trip via Pan Am
- luxury accommodations
- two meals daily in Nairobi
- full sightseeing, incredible wildlife
- American Tour Manager

GRAB YOUR CAMERA
AND AIM FOR ACTION!

YOUR KENYA EXPERTS-GENERAL TOURS-WON the famous ASTA travel Trophy two consecutive years for outstanding development in African tourism.

*per person double occupancy from NY

Member of the First Family of Travel

What A Way To Go!

GENERAL TOURS, INC.
711 THIRD AVE.
NY,NY 10017
212-687-7400

NH 8/82

YES! TAKE ME TO KENYA WITH THE AFRICAN EXPERTS Please send my free copy of KENYA ACTION SAFARI

name ______________
address ______________
______________ zip ______
my travel agent: ______________

Quince Essentials

Although it resembles an apple, the quince is too hard and too acidic to eat out of hand

by Raymond Sokolov

> They dined on mince, and slices of quince
> Which they ate with a runcible spoon;
> And hand in hand, on the edge of the sand,
> They danced by the light of the moon.
>
> Edward Lear,
> "The Owl and the Pussycat"

In this most famous of his *Nonsense Songs*, Lear concocted a nonmeal, a repast no one in everyday life would ever eat. The menu makes "sense," however, as poetry. Mince and quince rhyme. Their metrical position matches the internal rhyme of hand and sand in the first line of the next couplet. This is highly ordered verse, and its zaniness has a surreal but rigorous logic behind it. But the meal it hymns is all dessert, eaten with a recherché serving utensil not normally brought to the mouth. (The runcible spoon is not even a spoon but a fork with a sharp edge and three tines curved to form a spoonlike bowl.) And anyone who has the slightest familiarity with quinces will know that they cannot be eaten in slices. Their flesh is too hard and too acid to consume as is, sliced or even bitten from the fresh fruit. Only cooked to a pulp and sweetened does the quince turn into practical food.

The common orchard quince (*Cydonia oblonga*) is, in fact, the only fruit we have inherited from European culinary tradition that cannot be eaten out of hand. I am speaking of fruit not in the botanical sense but in the vernacular, which excludes nuts and many seeded "vegetables" such as eggplant and squash. I suppose there may be a few purists out there who refuse to allow their children to call an avocado a vegetable. But they are disregarding a practical distinction between fruits and vegetables that the youngest among us makes easily out of his own vivid palatal experience.

In this counter-Linnaean system of classification, a fruit is an edible plant soft enough to chew when raw and sweet enough for dessert. The definition works even for close cases. Both bananas and plantains are sweet enough to be "fruits," but plantains have to be cooked, which makes them "vegetables." Tomatoes are fine to eat out of hand. One of my most joyous taste memories is of gobbling three big ones, and happily letting the juice dribble over my chin, at a long stopover for Greek customs, where a local farmer provided us passengers on the Simplon Orient Express with our first food after a 24-hour famine coming through Yugoslavia. But tomatoes are too acid to qualify as dessert, except in eccentric, heavily sugared inventions such as tomato ice cream. Nuts straddle the line of demarcation. You can chew them uncooked and they go down nicely after supper. But to me they are neither fish nor fowl, not sweet or soft enough to count as fruits, and yet only a madman would call a walnut a vegetable.

Quinces are the hardest case of all. They aren't soft, and they aren't even particularly sweet. They are what you might call (speaking, as ever, colloquially) fruits by analogy. They grow on trees and look roughly like apples or pears with yellow skins. This resemblance occurred to the ancients, who called quinces Cydonian apples and Cydonian pears.

Cydonia (now Khaniá), a place on the northwest coast of Crete, was evidently an early center of quince production. By the time of Aristophanes, the fruit was so well known that it could be turned into an erotic metaphor. In *The Acharnians*, the hero, Dikaiopolis, comes on stage with two courtesans and boasts that their breasts are firm as quinces. There is also a Greek verb, literally "to quince," that was applied to things that swelled. And the Latin elegiac poet Propertius included quinces in an Edenic scene of country life rich with berries and grapes and baskets of flowers.

I surmise that this classical enthusiasm for the quince began with a taxonomic mistake. Someone mistook a quince for an apple, tasted it, and decided to cook it as a common-sense solution to the problem of what to do with this "bad apple." Such confusion persisted in the naming of the quince. Indeed, the ancient nomenclature classed most large tree fruits as apples, with a modifying adjective sometimes attached for more specific identification.

The influence of the loose ancient conceptualization of fruits persists today in romance languages. The Cydonian apple of the Greeks survives in modern Italian's word for quince: *melacotogna*. Spanish has transferred its version of the same term, *melocotón*, to the peach (probably because peaches used to be grafted onto quince stock). In the Hispanic world today, the quince is called *membrillo*. Other languages have dropped the apple component but kept Cydonia in altered, cognate form, as in the French *coing*, German *Quitte*, English *quince*, as well as the obsolete word *coyne* (really the singular of quince), and a rare term for quince syrup or jelly, *quiddany*.

In Greece today, quince preserves are still common. An elaborate Greek "spoon sweet" has almonds and rose geranium leaves added to it for aroma and texture. Many other countries and cultures also dote on quince jellies and marmalades.

Marmalade actually began as a quince preserve. The name comes from the Portuguese *marmelo*, a kind of quince. This confection seems to have been extremely popular across sixteenth-century Europe. France knew it as *cotignac*. And colonial American women devoted themselves to an extremely refined British family of recipes and procedures for exploiting the fruit. The manuscript recently published as *Martha Washington's Booke of Cookery*, which is a transcription of two early British cookery books, contains no fewer than thirteen recipes for preserved quinces and quince marmalades. Apparently, women in those days prided themselves on cooking quinces so that they turned a rainbow of colors, from white to red, yellow, amber, green, and the *orient culler*, the flush of rosy-fingered dawn. In all, this book gives twenty-two quince recipes, a startling profusion.

Over the years almost all of this quince expertise died out and with it the connoisseurship that cared to distinguish the fine degrees of differing solidity between quiddanies and jellies. Certainly, Martha Washington did not successfully transmit

Common orchard quince
(Cydonia oblonga)

Mary M. Thacher, Photo Researchers, Inc

her skill and interest in quince paste down the decades into this century.

Nevertheless, these dense sweets have returned to the American scene, thanks to the arrival of Spanish-speaking immigrants, who dote on them. The most popular Hispanic fruit paste, available at hundreds of ethnic markets in major cities, is based on guava. But the elite of the fruit pastes in the Hispanic community is quince.

Not long ago I received a letter from a reader in Indiana, Thomas Elgin, who described witnessing the preparation of quince paste in the home of Dr. Silvio Jova, a Cuban immigrant (see recipe). The fruit he used came from a neighbor's long-ignored tree. The method, down to the soaking of the seeds to extract their pectin, is remarkably similar to an Elizabethan recipe for quince paste in the Martha Washington collection.

The finished paste, firm and deep red, accompanies dark meat and game, and it is also commonly eaten for dessert with cheese, especially at Christmas. By then, all the tough-seeming but very easily bruised yellow fruits that ripened in October have been preserved for future enjoyment by those happy few who understand the quince.

Raymond Sokolov's new book, Fading Feast *(Farrar, Straus and Giroux), is a collection of food columns that first appeared in* Natural History.

Tunisian Fish Couscous with Quince and Raisins

(from *Mediterranean Cooking*,
by Paula Wolfert)

½ cup dried chickpeas or 1 cup canned cooked chickpeas, drained
2 pounds porgies or scup, cleaned and trimmed (keep heads and trimmings)
Salt
Pepper
4 cups couscous
⅓ cup olive or vegetable oil
1 pound tomatoes, chopped
1 onion, quartered
1 celery rib, chopped
1½ teaspoons sweet paprika
2 quince (1 pound) peeled, quartered, and sautéed in 2 tablespoons butter for 3 minutes
½ cup raisins
Bharat (a mixture of 2 parts ground cinnamon and 1 part ground, dried rosebuds)
2 tablespoons unsalted butter at room temperature

1. Cover the dried chickpeas with water and soak overnight.
2. The next day, drain the chickpeas and cook in fresh water to cover for one hour (if using canned chickpeas, peel them and set aside until step 10).
3. Slice the fish crosswise into six even portions. Rub the flesh with salt and pepper and set aside.
4. Wash the couscous in a large shallow pan, pouring 3 quarts of water over it. Stir with the hand quickly; then drain water in a sieve. Return to the pan and let grains swell for ten to twenty minutes. After ten minutes or so, work the grains lightly by hand to eliminate lumps.
5. Heat the oil in the bottom of a couscousière. Add tomatoes, onion, celery, and fish heads. Cook, stirring, two to three minutes. Add the paprika and 2 quarts of water. Season with salt and pepper. Bring to the boil, reduce heat, and simmer, covered, for thirty minutes.
6. Dampen a strip of cheesecloth, dust it with flour and twist it into a strip long enough to fit around the rim of the bottom part of the couscousière. Use it to seal the perforated top of the couscousière into the bottom part. Having effected this seal, so that steam from the broth rises only through the perforations, slowly dribble ¼ of the couscous into the steamer, allowing the grains to form a soft mound. Steam five minutes and gently add the remaining couscous. Over moderate heat, steam twenty minutes. Do not cover.
7. Remove the top part of the couscousière. Dump the couscous into the shallow pan and spread out with a wooden spoon. Sprinkle ½ to 1 cup cold water and 1 teaspoon salt over grains. Separate and break up lumps with oiled hands. Let dry another ten minutes. Cover with damp cloth.
8. Meanwhile, drain chickpeas you have cooked, cool, and remove the skins by submerging in a bowl of cold water and rubbing. Skins will rise. Discard skins.
9. Strain the fish broth and return to the couscousière. Bring to a boil, add chickpeas, sautéed quince, and raisins. Simmer thirty minutes.
10. Twenty minutes before serving, add the fish and peeled canned chickpeas (if used) to the broth. Wet your hands and work out any lumps in the couscous. Bring the broth to a boil, reseal the perforated top of the couscousière, and steam couscous another twenty minutes.
11. Rub 1 teaspoon bharat into the butter. Dump the couscous onto a large serving dish and toss with the spiced butter, using a fork to smooth out any lumps. Spread out and form a well in the center. Remove the fish from the broth with a slotted spoon and place in well (discarding any loose bones). Cover with the chickpeas, raisins, and quince. Correct seasoning of broth and use it to moisten the couscous. Decorate with lines of bharat and serve hot. Pass remaining broth in a sauceboat.

Yield: 6 servings

Quince Paste

(with thanks to Thomas Elgin
and Silvio Jova)

1 dozen quinces
Juice of 2 lemons
Sugar

1. Rinse the quinces in lukewarm water. Peel and core them, setting the seeds to soak in enough water to cover them.
2. Cut up the peeled fruit into small pieces and put in a large pot. Add lemon juice and water equal to half the volume of the quinces.
3. Bring quince mixture to a boil, reduce heat, and simmer until the pulp softens and can easily be mashed with a spoon. This process may take up to two hours. Skim periodically.
4. Remove from heat and push through a sieve or purée in a food processor. Weigh or measure the purée.
5. Put purée in a large, clean pot. Add the water in which the seeds have been soaking. Then add sugar; the exact amount will vary according to taste. If you measured the purée, the acceptable range runs from ¾ cup sugar (for every cup of purée) to as much as 2 cups. If you weighed the purée, you might begin by adding sugar pound for pound of quince, then taste and add more sugar as desired.
6. At this point, two methods are available for finishing the paste. Either you can cook the mixture slowly for 2¼ to 3 hours until it turns red and is difficult to stir; or you can simply simmer the purée until it reaches the soft ball state (234°–238° on a candy thermometer). Pour into a shallow pan, beat for ten minutes and let cool overnight.

ECUATORIANA

ECUATORIANA

All of South America. The easy way.

We make the business and vacation opportunities of South America easy to reach. And easy to enjoy. And we do it by giving you much, much more than a confirmed seat on a jet going south.

We've programmed our experience into the unique Ecuatronix computer complex. It is the information center that books and confirms the details of your travels all over the Southern Hemisphere. Not only on Ecuatoriana but on connecting local flights, land transportation, car rentals and accommodations if you wish, as well. So you know your travels in South America will be as smooth and comfortable as your flight.

On board, you'll be offered gourmet dining, in-flight entertainment and the prompt, professional attention of some of the most experienced flight attendants in all commercial aviation.

We bring you to the destinations direct or with easy connections from New York, Los Angeles and Miami.

Flying to South America has never been easier for you, your family and your company.

Call toll-free for information and reservations:
800-ECUADOR (800-328-2367).
In Miami, (305) 592-0200. In Canada, 800-268-7537.

ECUATORIANA
the airline of all the Americas®

Renault Fuego. From the first people to turbocharge Grand Prix racing and win on three continents. Wind-smooth styling that simmers with the performance of a fuel injected 1.6 litre engine. EPA's that give you $\boxed{24}$ est. MPG, 36 est. hwy.*

Renault Fuego. An optional Turbo for performance that's more responsive yet offers EPA's of $\boxed{26}$ est. MPG, 39 est. hwy.*

Renault Fuego. Aerodynamics more slippery than the Porsche 928. Agile front-wheel drive. Five forward speeds or optional three-speed automatic. And standard Michelin radials. All give Fuego the handling you'd expect from the leader in front-wheel drive.

Renault Fuego. Body-contoured seating. Full instrumentation. Even an optional oversize sunroof. Plus American Motors' Buyer Protection Plan® with the only full warranty that gives you 12-month/12,000-mile coverage of every part, except tires, even if it just wears out.

The new Renault Fuego. Racy and less than $8,500.**

*Compare 1982 EPA estimates with estimated MPG for other cars. Your actual mileage depends on speed, trip length and weather. Actual highway mileage will probably be lower.
**Manufacturer's suggested retail price. Price does not include tax, license, destination charges, aluminum sport wheels, touring interior and other optional or regionally required equipment.

Fuego
RENAULT

New. Racy. Fuego.

RENAULT
American Motors

NATURAL HISTORY

$2

9/82

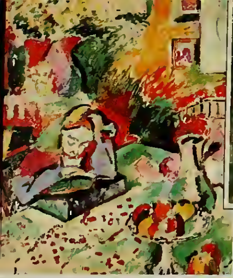
Now you can own a private library of fine art...
Fully bound in luxurious, genuine leather
and accented with 22kt gold.

GREAT ART AND ARTISTS

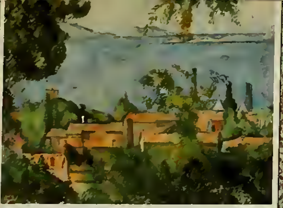
Chagall
Gauguin
Renoir
Claude Monet
Degas
Matisse
Van Gogh
Mary Cassatt
Picasso

Shown much smaller
than actual 9" x 12" size.

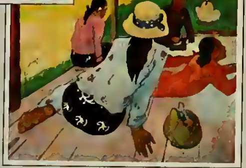
Lift here ►



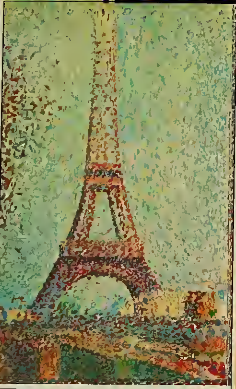
Girl Reading (La Lecture);
Henri Matisse, 1905-06



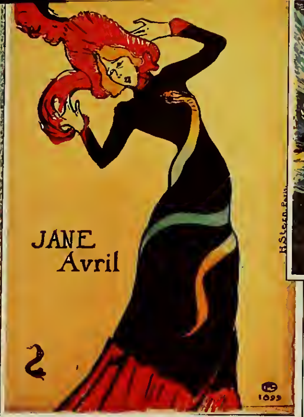
L'Estaque;
Paul Cezanne, 1884



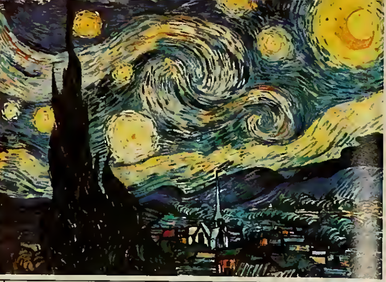
Siesta;
Paul Gauguin, 1893



The Eiffel Tower;
Georges Seurat, 1889



Jane Avril;
Henri Toulouse-Lautrec, 1899



The Starry Night;
Vincent van Gogh, 1889

Woman With a Fa
Pablo Picasso, 1

Every book is fully bound in genuine leather and accented with 22kt gold.

Leathers of many hue grains assure a rich and va library.

Full color oils, water colors and washes combine with drawings and sketches to give you the full breadth of the artist's work.

Page edges are protected with a lustrous golden finish.

Ribbon page markers make a distinctive finishing touch for each book.

Fine art has long found an important place in distinguished homes. It adds meaning and beauty to our lives—stature and elegance to our surroundings.

Of course the world's greatest works have long ago disappeared into the great museums and collections. Thus, art lovers for centuries have become art book collectors. For in this way alone is it possible to own, enjoy and experience in one's home hundreds of works of art, by many different masters, assembled from leading museums and private collections.

With a library of fine art books, you can take an art tour of the world, just by turning pages. And, with an expertly written text as your guide, you can develop a full appreciation of art—what the masters accomplished and how it can enrich our lives.

An affordable leather-bound library. A breakthrough in art book collecting.

For generations, the most discerning art lovers in Europe and America have acquired luxurious art books fully bound in leather. For leather-bound art books have long represented the finest way of owning great art. Beautiful leather-bound books enhance the enjoyment and appreciation of great art, just as they enhance the experience of great literature. And such art books add distinction and beauty to a home, becoming a meaningful heirloom for future generations.

Until now, though, luxurious leather-bound art books have been available only from a few book dealers and have commanded forbidding prices. Under these circumstances, few of us could hope to own a leather-bound art collection of significant size or scope.

Fortunately, the Easton Press, which has been making available the world's finest literature in luxurious leather-bound volumes at a reasonable cost, is about to do the same with the world's finest art. Now you have the opportunity to own GREAT ART AND ARTISTS—the first comprehensive collection of fine leather-bound art books decorated with 22kt gold to be published at an easily affordable price.

The great art of the modern masters—from Van Gogh and Monet to Picasso and his contemporaries.

Here are magnificently bound, expertly written fine art books, each devoted to the life and work of a great master of 19th or 20th century art.

You'll see the great works of Van Gogh—a man driven by such passion that he virtually assaulted his canvases. And Claude Monet, the "Father of Impressionism," whose brush strokes will invite your eye to see and blend light just the way he intended.

Renoir, whose delicate colors show you a joyous, robust love of the physical world. Gauguin, who found in primitive faith and folk art a way to approach the most basic questions of life. Degas, whose famous paintings of dancers will reveal to you a new way of looking at light, color and form.

And Pablo Picasso, whose long and brilliant career encompasses virtually every major movement of contemporary art. Other great modern artists—including Matisse, Braque, Miro, Kandinsky, and Chagall. And Paul Klee, whose rich imagery and symbolism provide a key for understanding the purpose behind much of modern abstract art.

Each book narrates the artist's life, tells of his influences and how he influenced others. Each book displays the artist's major works and examines them in detail—showing you what to look for, what to appreciate, why the particular work is important. What's more, many rarely seen paintings, even drawings and studies, have been included to create the full and varied experience of the artist's whole work.

Beautiful full leather bindings.

In every respect, these will be among the most beautiful art books ever produced, regardless of cost. Each book will be fully bound in richly grained real leather—not only on the spine, but also the front cover and back cover as well. Each volume will have the elegant look, feel, and distinctive aroma that can only be achieved with real leather.

Accented with 22kt gold.

To create a truly distinctive collection, the front cover of each volume will be beautifully inlaid—in 22kt gold—with the signature of the artist. And to complement the binding, the page ends will be gilded along all three sides with a radiant golden finish.

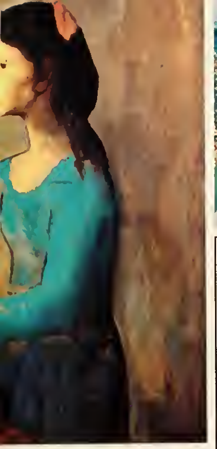
There will be other elegant touches, too. The end papers of each volume will bear a rich design befitting books of great stature. Each book will be bound with a permanent ribbon page marker. A handsome nameplate will accompany each volume to allow your own personalized identification of each book as part of your private collection.

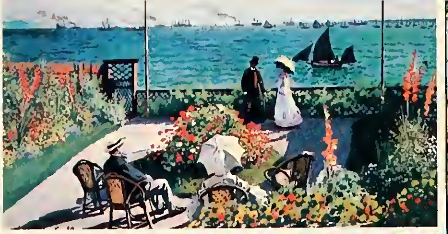
Available Only by Advance Subscription

GREAT ART AND ARTISTS will be printed and custom-bound in a private edition for subscribers only. No books will be made available to bookstores or rare book dealers. This limited, direct distribution assures a scarcity that will enhance your esteem for your private library.

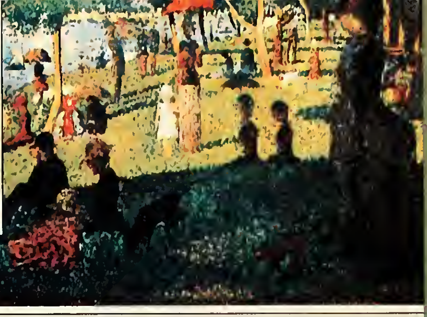
Convenient Acquisition Plan

The books in this collection will be





Terrace;
Claude Monet, 1866



A Sunday Afternoon;
Georges Seurat, 1885

The front cover of each book is decorated with real 22kt gold.

issued one per month. You pay for only one volume per month and will have a full month to enjoy each new volume before the next one arrives. As your collection builds, so will your understanding and appreciation for the finest art.

An Astonishing Value at Only $29.50

You might expect comparable art books, bound in leather and decorated in gold, to sell for at least $60 or $75 per volume. However, the volumes in this collection will be priced at only $29.50 each for the first two years. Future volumes will be similarly priced, subject only to minor periodic adjustment to reflect varying material costs.

This extraordinary value is possible for three reasons. First, Easton Press will produce this collection for subscribers only—thus, enabling us to set precise print orders. Second, we have purchased the reproductions for this collection from the most respected and prestigious art publishers of Europe and America. Thus, much of the otherwise prohibitive cost of photographing and reproducing such a vast collection of fine art has already been absorbed long ago. Finally, there is up-to-date American and European book crafting technology helping to produce these books at a high standard of quality.

These advantages accrue directly to you—allowing you to participate in a publishing breakthrough of historic proportion.

Important Assurances

You will never be required to keep any books you do not want. Your satisfaction is guaranteed. You may return any volume within 30 days for a full refund of your purchase price. And you are free to cancel your subscription at any time.

Only so many subscribers can be accommodated, and we reserve the right to discontinue this offer when demand exceeds our capacity to produce. To avoid possible disappointment, please complete the Subscription Application as quickly as possible and return it directly to the Easton Press.

Subscription Application 85

GREAT ART AND ARTISTS

The Easton Press
47 Richards Avenue
Norwalk, Conn. 06857

No payment required.
Simply mail this application.

Please enroll my subscription to the Great Art and Artists collection of leather-bound art books. Send me the first volume and reserve a collection in my name. Further volumes will be sent at the rate of one book per month. I will be billed $29.50* prior to shipment of each book. This price will be guaranteed to me for the next two full years.

I understand that I may return any book within 30 days for refund, and that either party may cancel this subscription agreement at any time. *plus $2.00 for shipping and handling

Name ____________________

Address ____________________

City ____________ State ____________ Zip ________

☐ As a convenience, I wish to pay for my first volume now. I enclose $29.50 (plus $2.00 shipping and handling—a total of $31.50**). ** Conn. residents pay $33.86 to include tax

☐ Please charge each monthly book to my credit card:
☐ VISA ☐ MasterCard

Credit Card No. ____________________ Expiration Date

Signature ____________________

Allow 8-12 weeks after payment for initial shipment. All applications subject to acceptance.

ECUATORIANA

ECUATORIANA

All of South America. The easy way.

We make the business and vacation opportunities of South America easy to reach. And easy to enjoy. And we do it by giving you much, much more than a confirmed seat on a jet going south.

We've programmed our experience into the unique Ecuatronix computer complex. It is the information center that books and confirms the details of your travels all over the Southern Hemisphere. Not only on Ecuatoriana but on connecting local flights, land transportation, car rentals and accommodations if you wish, as well. So you know your travels in South America will be as smooth and comfortable as your flight.

On board, you'll be offered gourmet dining, in-flight entertainment and the prompt, professional attention of some of the most experienced flight attendants in all commercial aviation.

We bring you to the destinations direct or with easy connections from New York, Los Angeles and Miami.

Flying to South America has never been easier for you, your family and your company.

Call toll-free for information and reservations:
800-ECUADOR (800-328-2367).
In Miami, (305) 592-0200. In Canada, 800-268-7537.

ECUATORIANA
the airline of all the Americas®

NATURAL HISTORY

Vol. 91, No. 9, September 1982
American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director
David D. Ryus, Vice-President

4 Authors

6 This View of Life *Stephen Jay Gould*
Solitary Origins of Some Societies

14 Dating Very Old Objects *George W. Wetherill*
How do you tell if you have found the oldest rocks on earth?

22 What Hath Night to Do With Sleep? *Martin C. Moore-Ede*
Human internal clocks were designed for the good old days.

26 Sky Reporter *Robert P. Kirshner*
Hole in Space

30 Mother Baboon *Joan Luft and Jeanne Altmann, photographs by David Stein*
High-ranking females raise their daughters for high-status positions.

40 Northern Birds at Home in the Tropics *John W. Fitzpatrick*
"Our" birds are full-fledged members of tropical communities.

48 Journey to the Tibetan Plateau *Orville Schell, photographs by Robert Gordon*
Like the snow leopard they hunt, the Golaks' nomadic life style is endangered.

58 Masters of the Tongue Flick *Carol A. Simon*
Some lizards stick out their tongues continually, others rarely. Why?

68 Celestial Events *Thomas D. Nicholson*

72 Additional Reading

74 Books in Review *Boyce Rensberger*
In Elephant Country

80 At the American Museum
Nestworks

84 A Matter of Taste *Raymond Sokolov*
Blue Notes

Cover: *Eastern kingbirds are known in North America for their pugnacity. But in South America where they winter, these birds roam in huge flocks and may thereby avoid conflicts within tropical bird communities. Photograph by Robert P. Carr. Story on page 40.*

Alan Ternes, Editor
Managing Editor: Erik Eckholm
(Judith Friedman, on leave)
Thomas Page, Designer
Board of Editors: Carol Breslin,
Sally Lindsay, Frederick Hartmann,
Vittorio Maestro, Rebecca B. Finnell
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
E. Kay Danzig, Art Asst.
Kay Zakariasen, Picture Editor
Annie R.C. Finch, Editorial Asst.
Lillian Berger

L. Thomas Kelly, Publisher
Bradford D. Smith, Business Manager
Ernestine Weindorf, Administrative Asst.
Carol A. Midkiff
Cary Castle, Circulation Manager
Jeff Pieper, Assoc. Circulation Mgr.
Ramón E. Alvarez, Asst. Circulation Mgr.
Frank Stevens, Circulation Asst.
Frederick E. Grossman, Production Manager
Debra Buck McCord, Asst. Production Mgr.
Elaine M. Callender, Advtg. Production Mgr.
Douglas J. Preston, Publications Manager

Natural History *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Subscriptions: $15.00 a year. In Canada and all other countries: $20.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.* *Copyright © 1982 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of* Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.* Natural History *is indexed in* Reader's Guide to Periodical Literature.

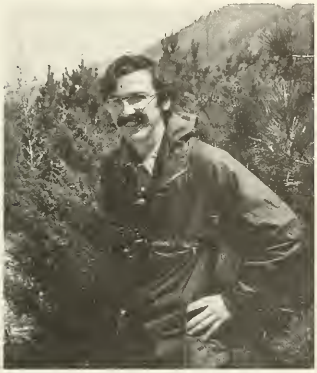
Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225

Subscription orders, change of address notices, undeliverable copies, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

One of the originators of the Amboseli National Park Baboon Project in Kenya, **Jeanne Altmann** (right) has been working with this intensively studied group of primates since 1971. The project, with bases at Cornell University and at the University of Chicago, where Altmann is a research associate in biology, has produced some of the most detailed field records of any wild primate species. Still concentrating on the Amboseli baboons, Altmann is now investigating, among other things, the animal's intra- and inter-generational consistency in parental care, nutritional effects on maternal care and infant development, long-term effects of early experience, and the causes and consequences of differences in family structure.

Coauthor **Joan Luft** (left) became involved with the baboons when she worked in the University of Chicago laboratory of the Amboseli Project. From 1978 through 1981, she assisted in manuscript preparation and data analysis, maintenance of contact with the field site, and organization of the lab's data base. Luft is currently an administrative assistant in the Department of Psychiatry at the university, as well as a freelance writer and translator.



John W. Fitzpatrick began using his parents' binoculars to look at birds when he was four and has not missed a Christmas Bird Count since he was six. He is currently associate curator and head of the Bird Division at Chicago's Field Museum of Natural History, where his research interests include the taxonomy, distribution, and ecology of South American birds; the evolutionary radiation of New World flycatchers; and cooperative breeding in Florida scrub jays. When not studying birds, Fitzpatrick enjoys painting them and finds that "discovering new species (six to date) provides an avenue for getting my paintings published."

In the summer of 1981, **Orville Schell** joined an expedition of Americans and Canadians climbing and trekking in the mountains of the Tibetan plateau. Schell, a writer, earned his B.A. degree in Far Eastern history at Harvard University, then went on to do graduate work in Chinese history at the University of California, Berkeley. He has written six books on China, speaks Chinese, and has contributed articles to such magazines as *Life*, *The New Yorker*, *Harper's*, and *Rolling Stone*. At present, Schell is working on a film on China and Taiwan to be shown on the Public Broadcasting System.

The Southwestern Research Station of the American Museum of Natural History, located at Portal, Arizona, has long been a mecca for students of reptilian behavior. The environs are especially rich in lizards, and biologists like **Carol A. Simon** have managed to decipher much about their behavior at the station. Simon has done work there since high school—as a student, station volunteer, assistant cook, field research aide, and predoctoral and postdoctoral fellow. Her present research is focused on chemoreception of animals. She is a research associate in the Museum's Department of Herpetology and an associate professor of biology at City College of C.U.N.Y.

A mallard whistles low over the lake. Trout break the water's surface. A wood fire crackles.

Enjoying nature's music doesn't mean you can't enjoy your own. Next time you set up your camp, set up your music, too. With JVC's newest portable radio cassette, the RC-M90.

You get AM and FM stereo and six short wave bands. A full logic control tape system. And huge (8 inch) bass reflex speakers.

So for music in the middle of anywhere, visit a JVC dealer today.

JVC COMPANY OF AMERICA
Home Entertainment Division,
41 Slater Drive, Elmwood Park, N.J. 07407
JVC CANADA INC., Scarborough, Ont.

Solitary Origins of Some Societies

The "wondrous indefiniteness of evolution" includes many quirky shifts in function

by Stephen Jay Gould

Posthumous triumph is hollow, however abstractly rewarding. Nanki-Poo refused Ko-Ko's inducement to undergo a ceremonious public beheading rather than a private suicide: "There'll be a procession—bands—dead march—bells tolling . . . then, when it's all over, general rejoicings, and a display of fireworks in the evening. You won't see them, but they'll be there all the same." And I never could figure out why America's premier nineteenth-century anthropologists J.W. Powell and W J McGee made a bet about who had the larger brain—to be settled by autopsy when the joy of victory could no longer be savored.

Nonetheless, I just made a dumb bet with a female jogging enthusiast: that no woman would win the Boston marathon in my lifetime. I'd rather lose, but expect I won't. Still, if superior average speed of running males is among the few insignificant, but genuinely biological, differences between human sexes, I can only respond to charges of gloating (for the abstraction I represent, but not, alas, for me and my huffing eight-minute miles) with a statement of genuine regret. How gladly would I trade this useless advantage for the most precious benefit of being female—several extra years of average life.

I do not know whether shorter male life is a generality in nature—and whether we should therefore add to smaller average size (see July's column) another biological strike against machismo—but I just learned (with thanks to Martin L. Adamson) about an instructive extreme case.

In 1962, James H. Oliver, Jr., traced the life cycle of a mite that parasitizes the cocoons of earthworms (*Journal of Parasitology*, vol. 48, p. 120). Both males and females of *Histiostoma murchiei* pass through an egg and three juvenile stages before molting into an adult. In addition, the female intercalates one additional stage—euphoniously named the hypopus—between the second and third preadult phases. Females develop at a leisurely pace for such a small creature. Discounting the hypopus, the passage from egg to adult, through stages held in common with males, takes one to three weeks. The additional hypopus may extend female life greatly—for these mites find and infest other cocoons only while in the hypopal stage (males always stay at home). The hypopus may, first of all, remain dormant for long periods within the skin of the previous juvenile stage, awaiting (so to speak) favorable conditions for emergence and movement to another cocoon. When the hypopus does emerge, it may then live for a long time, moving about in its own cocoon (and sometimes becoming dormant again) or moving out in search of a new home.

Males, by contrast, race through the same stages (minus the hypopus) with a celerity that should inspire Bill Rodgers as he trudges up Heartbreak Hill next Patriot's Day. "Adult males," Oliver writes, "have been observed copulating with their mother within three to four days after being laid as eggs," and they die soon after this bout of incestuous joy. Why this outstanding difference in life span between the sexes? And what has it to do with the Oedipal habits of these mites? A further look at the unusual reproductive biology of these parasites seems to provide the answer.

When a hypopus finds a new cocoon, it lays two to nine eggs within two days after molting into an adult—and without benefit of fertilization. All these eggs develop into males, the only source of potential husbands. What better evolutionary rationale for rapid male development could we hope to find? The females of most species must seek their husbands. These mites make them from scratch and then wait. Males of *H. murchiei* are little more than sources of sperm; the sooner they can perform, the better.

Two days after her incestuous mating, the female begins to lay eggs again and may continue for two to five days, producing as many as 500 offspring—all female this time.

Yet in solving one problem—the differential speed of development between sexes—we have only encountered more curious questions: How can this system work in the first place? How can an unmated female, alone in a new cocoon, produce a generation of husbands? And why are the offspring of her next reproductive bout all female?

The answers lie in the unfamiliar style of sex determination in these mites. In most animals, both males and females have paired chromosomes, and the status of one pair determines the sex of its bearer. Human females, for example, have two large sex chromosomes (designated XX), while males have one large (X) and one small (Y) chromosome in their determining pair. All unfertilized egg cells carry a single X, while sperm carry either an X or a Y. We each owe our sex to the good fortune of one sperm among the millions per ejaculate. Animals with paired chromosomes in both sexes are called diploid.

Some animals use a different system of sex determination. Females are diploid, but males have only one chromosome for each female pair and are called haploid (for half the diploid number). In other words, males—ironic as this may seem—develop from unfertilized eggs and have

KAHLÚA®
&
cream
KAHLÚA
IMPORTED
FROM SUNNY MEXICO
KAHLÚA
HECHO EN MEXICO
LICOR DE CAFÉ
COFFEE LIQUEUR
PRODUCT OF MEXICO
"frrresh"

One of the most naturally delicious drinks imaginable: an ounce of Kahlúa, four ounces of cream, or milk, over ice. And, since you make it yourself, a taste as frrresh as can be. The Kahlúa recipe book tells all. Do send for it. Our treat.

Maidstone Wine & Spirits Inc., P.O. Box 8925, Universal City, CA 91608.

© 1981 Kahlúa Imported Liqueur 53 Proof

Announcing a remarkable series of
twelve collector's plates by the Orient's outstanding artist in the classic Rimpa style
. . . her first works of art in porcelain

Birds and Flowers of the Orient

BY NAOKA NOBATA

The Peacock and the Peony
PLATES SHOWN SMALLER THAN ACTUAL SIZE OF 10-1/4" DIAMETER.

SUBSCRIPTION APPLICATION

Birds and Flowers of the Orient

BY NAOKA NOBATA

Please mail by September 30, 1982
Limit: One collection per person

Franklin Porcelain
Franklin Center, Pennsylvania 19091

Please enter my subscription for the *Birds and Flowers of the Orient* porcelain plate collection, bearing original works of art by Naoka Nobata.

I need send no payment now. The twelve plates are to be sent to me at the rate of one plate every *other* month. I will be billed for each plate in two monthly installments of $27.50* each, with the first payment due in advance of shipment.

**Plus my state sales tax*

Signature ____________________
ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE.

Mr./Mrs./Miss ____________________
PLEASE PRINT CLEARLY

Address ____________________

City, State, Zip ____________________

© 1982 FP

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

JU

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO 1 FRANKLIN CENTER, PENNSYLVANIA

POSTAGE WILL BE PAID BY ADDRESSEE

FRANKLIN PORCELAIN
Franklin Center, Pennsylvania 19063

Each plate bears an original work of art created by Naoka Nobata exclusively for this collection.

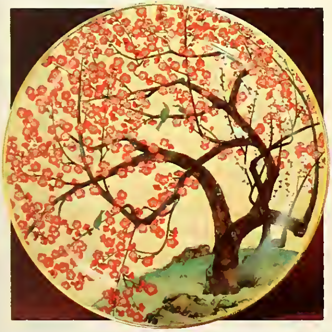
Available by subscription only.

Please enter your subscription by September 30, 1982.

THE ARTIST. Naoka Nobata is one of the most brilliant and imaginative of today's painters in the traditional Oriental style. She is celebrated throughout her native land both for her exceptional talent and the sensitivity of her technique. Indeed, Mme. Nobata is today's foremost exponent of the classic "Rimpa" tradition of Oriental art—which marvelously intertwines the real and the imaginary.

The works of Naoka Nobata have been shown at important art exhibitions throughout Japan, including the first Sogakai Exhibition, and she has been honored with a one-woman show at the distinguished Shirota Gallery. In addition, her paintings have been exhibited in the Tokyo Central Art Gallery and the Miyuki Gallery, and her work has been acquired by many prominent collectors including the leading art critic Tetsuji Takechi for his own private collection.

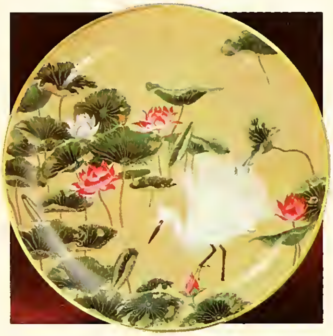
At the pinnacle of her career, Naoka Nobata has created her very *first* works of art in porcelain: *Birds and Flowers of the Orient.* A series of twelve collector's plates portraying exquisite flowers of Oriental lore and legend—and the exotic birds associated with them.



The Bush Warbler and the Apricot

Each plate is a distinctive work of art. Together, they form a collection that will enhance the beauty of any home. Rich in the symbolism of the Orient...imbued with its meaning...touched with its mystery...this is a collection that will provide endless hours of joy and inspiration.

BIRDS AND FLOWERS OF THE ORIENT PLATES. Each plate represents a different month of the Oriental year, and combines the flower and bird symbolizing that month. Deep green pine branches and the stately white crane for January...the Japanese iris and the Mandarin duck for May...the languid water lily and the exotic egret for August...the brilliantly colored chrysanthemum and the tree sparrow for October...the yellow narcissus and the graceful wren for December...Twelve flowers and birds of the Orient brought together in works of extraordinary beauty.



The Water Lily and the Egret

These collector plates will be exceptionally large—10-1/4 inches in diameter—to provide full scope for the artist's imaginative portrayals. And, as a finishing touch for Naoka Nobata's lovely designs, each plate will be *hand-decorated* with a border of *pure 24 karat gold.*

Moreover, each plate will be produced in the finest Japanese porcelain—highly prized for its translucence and strength. And the delicate, sensitive quality of the artist's work will be meticulously captured in every detail, every nuance, every line.

A wide variety of colors will be used in the creation of these designs. Brilliant reds and oranges contrasting with pale yellows, soft greens and cool aquas. Rich browns and ambers mingled with bright blues, subtle violets and magentas. All the lovely shades one might see in an Oriental garden. And to add to the uniqueness of the plates, elements of the design will form a charming floral border on the reverse.

AVAILABLE BY SUBSCRIPTION ONLY. The plates in the Birds and Flowers of the Orient collection will be crafted in Japan exclusively for individual subscribers to the series, and a limit of one collection of plates per person will be strictly enforced.

Reverse of plate bears title of the collection, artist's name and designation of fine porcelain.

Furthermore, this important collection of porcelain plates is available *only* by subscription and *only* from Franklin Porcelain, which is issuing the plates.

ENTER YOUR SUBSCRIPTION BY SEPTEMBER 30TH. The collection of twelve fine porcelain plates comprising the Birds and Flowers of the Orient will be sent to subscribers at the convenient and systematic rate of one every *other* month, and the issue price for each porcelain plate is just $55, payable in two monthly installments of $27.50 each. Included as part of the collection will be fascinating reference information and twelve individual wall brackets for attractive display of all the plates.

A Certificate of Authenticity will also be sent to each subscriber, attesting that the plates in this collection are original works of art by the distinguished artist Naoka Nobata.

To enter your subscription for this beautiful and unique collection of plates by Naoka Nobata—to own, to display in your home and to hand down to future generations of your family with pleasure and pride—please be sure to mail the accompanying postpaid subscription application by September 30, 1982.

It is not necessary to send any payment at this time. However, the Subscription Application attached should be mailed directly to Franklin Porcelain, Franklin Center, Pennsylvania 19091, by September 30th.

© 1982 FP

no fathers. Fertilized eggs produce diploid females. Animals using this system are called haplodiploid (because males are haploid and females diploid).

H. murchiei is haplodiploid. Hence, the unmated female in a new cocoon raises a generation of males from unfertilized eggs, and a subsequent generation of females from the resultant incest.

Haplodiploidy, a fascinating phenomenon rich in implication, has circulated through these columns in various contexts for years. It helped to explain the origin of social systems in ants and bees (November 1976), and it underlay the habits of a male mite that fertilizes several sisters within his mother's body and dies before "birth" (March 1980). It also circulates widely through the animal kingdom. Haplodiploid species have been found in rotifers, nematodes, mites, and in four separate orders of insects—the Thysanoptera (thrips), the Homoptera (aphids, cicadas, and their allies), the Coleoptera (beetles), and the Hymenoptera (ants, bees, and wasps). These groups are not closely related and their presumed common ancestors are diploid. Thus, haplodiploidy has arisen independently—and often many times—within each group. Although most of these groups contain only a few haplodiploid species amidst a host of ordinary diploids, the Hymenoptera, with more than 100,000 named species, are exclusively haplodiploid. Since vertebrates only include some 50,000 species, as Oliver reminds us, our chauvinistic impression that haplodiploidy is curious or rare should also be revised. At least 10 percent of all named animal species are haplodiploid, and those 100,000 hymenopterans form a good chunk of the 700,000 or so insect species that taxonomists have recognized.

Within the last decade, haplodiploidy has figured most prominently in the news (both general and scientific) for its role in an ingenious Darwinian explanation of an old biological mystery: the origin of sociality in Hymenoptera, particularly the existence of sterile "worker" castes, invariably female, in ants and bees. Since sociality evolved several times within the Hymenoptera, the invariant system of sterile female castes demands a general explanation. The larger problem is even more puzzling: Why, in a presumably Darwinian world filled with organisms acting only for their personal reproductive success, should large numbers of females "forgo" their own reproduction to help their mother (the queen) raise more sisters?

The ingenious explanation (in brief; see my previous column for more details) relies upon the peculiar asymmetries of genetic relationship between sexes in haplodiploid animals. In both diploids and haplodiploids, mothers pass half their genetic material (one set of chromosomes in each egg cell) to each offspring. They are therefore equally related (by half of their genetic selves) to both sons and daughters. A female in diploid species also shares approximately half her genes with both brothers and sisters. But a female in haplodiploid species shares three-fourths of her genes with sisters and only one-fourth with brothers, for the following reason. Consider any gene (on a single chromosome) in sisters. What is the probability that a brother will share it? If the gene is on a paternal chromosome, then the brother has zero probability of sharing it, for he has no paternal chromosomes. If the gene is on a maternal chromosome, then he has a 50 percent chance of sharing it with his sister because he either received the same chromosome from his mother or the other member of the pair. Thus, summing over all genes, the relationship between brother and sister is the average between zero (for paternal genes of sisters, necessarily absent in brothers) and 50 percent (for maternal genes), or 25 percent.

What then is the probability that a sister will share the same gene? If it is a paternal gene, the sister must share it since fathers have only one set of chromosomes and they pass their entire genetic program to each daughter. If it is a maternal gene, the chance is 50 percent by the same argument advanced for brothers. The total relationship between sisters is therefore the average between 100 percent (for paternal genes) and 50 percent (for maternal genes), or 75 percent.

Females are therefore more closely related to their sisters (by three-fourths) than either to their mothers (by one-half) or to their own potential offspring (also by one-half). If the Darwinian imperative leads organisms to maximize the numbers of their own genes in future generations, then females will do better by helping their mother raise sisters (as sterile workers do) than by producing their own offspring. Thus, the asymmetry of genetic relationship in haplodiploids may explain why worker castes of social Hymenoptera are invariably female and why sociality in this style has evolved many times in the Hymenoptera but not in the much larger array of diploid organisms. (As always, our complex world provides an exception —the diploid termites, relatives of cockroaches, which at least include both males and females in their worker castes.)

This explanation of an old mystery has so intrigued biologists that a subtle reversal of causality has crept into some accounts. The very existence of haplodiploidy is linked with force and elegance to the evolution of sociality, and we are almost led to believe that this mode of sex determination arose "for," or at least in the context of, the marvelous social organization of ants and bees. Yet a moment's explicit reflection assures us that this cannot be so, for two reasons.

First, *all* hymenopterans are haplodiploid, but only a few lineages within the group have developed complex social systems (most hymenopterans are asocial or minimally social wasps). The common ancestor of living hymenopterans must have been haplodiploid, but it was certainly not fully social since the complex society of highly derived bees and ants has evolved as a phyletic afterthought in several independent lineages. Causality must run in the other direction. Haplodiploidy does not exist for sociality unless the future can control the past. Rather, haplodiploidy arose for other reasons and then permitted, by good and unplanned fortune, the later evolution of this wonderfully complex and successful mode of sociality. But what other reasons? Which brings me, finally, to the point of this column, to the main reason for my fascination with *H. murchiei*, and more immediately, to the second item.

When we consider the usual ecological context of haplodiploidy in a broad range of animals that may have evolved it directly (and not merely co-opted it for another use), an interesting pattern emerges. *H. murchiei* shares a mode of life with the mites that die before birth and with many other haplodiploid animals in distantly related groups: all are "colonizers," species that survive by seeking rare but rich resources and then reproducing as fast as they can when uncommon fortune rewards their search (the vast majority of *Histiostoma*'s hypopi die before finding a fresh earthworm cocoon). Haplodiploidy provides several advantages in this chancy approach to survival. Successful colonization does not require two separate migrations of a male and a female or even that a single migrating female be fertilized before her search for a new resource begins. Any unmated female, even a juvenile, becomes a potential source of new colonies, since she can make a generation of males all by herself and then mate with them to begin a generation of females—the strategy evolved by *Histiostoma*.

When colonizers find a rich but ephemeral resource, haplodiploidy may enhance the speed of raising new generations by permitting fertilized females to control the sex ratio of their offspring. As I argued in my column on "death before birth," when brothers mate with sisters, more off-

Sets of permanent value at surprising savings.

The Encyclopedia of Philosophy
1-2
3-4
5-6
7-8

The Encyclopedia of Philosophy

for **$24.95** (Pub price $150)

The most comprehensive encyclopedia of philosophy ever published, this set traces ancient, medieval, modern, Eastern and Western thought. An essential and rewarding reference source for home libraries.

The Compact Edition of the Oxford English Dictionary

The Compact Edition of The Oxford English Dictionary

for **$24.95** (Pub price $125)

The "most complete, most scholarly dictionary of the English language"—*The Christian Science Monitor.* Through photo-reduction, the original 13-volume set has been reproduced in this two-volume *Compact Edition.* Magnifying glass included.

SARAH VAUGHAN
ELLA SINGS GERSHWIN
Billie Holiday
Ain't nobody's business if I do

Great Ladies of Song

for **$14.95** (Nonmember prices total $76.85)

Three Book-of-the-Month Club custom recordings: *Billie Holiday: Ain't Nobody's Business If I Do*; *Sarah Vaughan, American Singer*; *Ella Fitzgerald Sings Gershwin.* Available in records, 8-tracks or cassettes.

Bartlett's Familiar Quotations
Modern English Usage
The Harper Dictionary of Modern Thought
Roget's Thesaurus

Reference Library

for **$14.95** 5 Vols.

(Pub prices total $91.40)

The five indispensable works for the home or student library: *Bartlett's Familiar Quotations* (revised and enlarged edition), *A Dictionary of Modern English Usage* (Fowler's), *The Harper Dictionary of Modern Thought, Oxford American Dictionary* and *Roget's International Thesaurus.*

Our Oriental Heritage
The Life of Greece
Caesar and Christ
The Age of Faith
The Renaissance
The Reformation
The Age of Reason Begins
The Age of Louis XIV
The Age of Voltaire
Rousseau and Revolution
The Age of Napoleon
Will Durant

The Story of Civilization by Will and Ariel Durant

for **$29.95** (Pub prices total $307.45)

For almost half a century Will and Ariel Durant traced the continuity of world history—the religions and philosophies, the political and economic tides, the arts and sciences, the customs and conquests—to show the foundations of society today. A Book-of-the-Month Club exclusive for almost 50 years, the Durants' illustrated masterwork is history come alive.

Choose one of these five sets and save up to $277^50

You simply agree to buy 4 books within the next two years.

Facts About Membership. As a member you will receive the *Book-of-the-Month Club News®* 15 times a year (about every 3½ weeks). Every issue reviews a Selection and 150 other books that we call Alternates, which are carefully chosen by our editors. If you want the Selection, do nothing. It will be shipped to you automatically. If you want one or more Alternates—or no book at all—indicate your decision on the Reply Form and return it by the specified date. *Return Privilege*: If the *News* is delayed and you receive the Selection without having had 10 days to notify us, you may return it for credit at our expense. *Cancellations*: Membership may be discontinued, either by you or by the Club, at any time after you have bought four additional books. Join today. With savings and choices like these, no wonder Book-of-the-Month Club is America's Bookstore®

BOOK-OF-THE-MONTH CLUB®

America's Bookstore® since 1926.

Book-of-the-Month Club, Inc., Camp Hill, Pennsylvania 17012 **A113-9**

Check one box only.

- ☐ 912. Compact OED **$24.95**
- ☐ 913. The Story of Civ **$29.95**
- ☐ 917. Ency. of Philosophy **$24.95**
- ☐ 938. Reference Library **$14.95**
- ☐ 943. Great Ladies of Song (11 Records) **$14.95**
- ☐ 944. Great Ladies of Song (6 Cassettes) **$14.95**
- ☐ 946. Great Ladies of Song (6 8-Track Tapes) **$14.95**

Please enroll me as a member of Book-of-the-Month Club and send me the set I have checked at left, billing me for the appropriate amount, plus shipping and handling charges. I agree to buy 4 books during the next two years. A shipping and handling charge is added to each shipment.

Mr.
Mrs.________________________________ **2-64**
Miss (Please print plainly)

Address________________________ Apt.______

City________________________________

State________________________ Zip______

Prices shown are U.S. prices. Outside the U.S., prices are generally higher.

spring will people the next generation if mothers can put most of their limited reproductive energy into making females and produce only a minimal number of males (one will often do). Since one male may fertilize many females, and the reproductive rate of a population is limited by the number of eggs, not by sperm, why make vast numbers of superfluous males? The principle is fine in theory, but most animals cannot easily control the sex ratio of their offspring. Despite prayers and entreaties for boys in many sexist human societies, girls continue to assert their birthright (and birth rate) of nearly 50 percent.

But many haplodiploids can control the sex ratio of their offspring. If a female stores sperm within her body after mating, any eggs that bypass the storage area become males, while those that contact it become females. Haplodiploid mites with highly unequal sex ratios often produce a brood of female eggs and then shut off the sperm supply to add a male or two right at the end.

This complex of associated features—a colonizing life style, rare and ephemeral resources, rapid reproduction, and ease of rearing new generations in strange places—seems to define the original context of advantage for haplodiploidy. If we assume, as a hypothesis only, that haplodiploidy usually arises as an adaptation for life in this uncertain world, then it must be interpreted as a lucky accident with respect to its later utility in the development of sociality in ants and bees.

Now what could be more different, in our usual biological thinking, than the chancy life of a solitary female colonizer (whose offspring can hardly become very social on a resource that doesn't last more than a generation or two), and the complexity, stability, and organization of ant and bee societies? Is it not peculiar in the extreme that haplodiploidy, a virtual prerequisite for the evolution of hymenopteran societies, probably first evolved as an adaptation for a life style almost diametrically opposed (at least in its metaphorical implications)? If I can convince you that it is not peculiar at all, but an example of a basic principle that distinguishes evolutionary biology from a common stereotype about science in general, then this essay has succeeded.

To assume that the current utility of a feature permits an inference about the reasons for its evolutionary origin is a lamentably common error. Current utility and historical origin are different subjects. Any feature, regardless of how or why it first evolved, becomes available for co-optation to other roles, often strikingly different. Complex features are bursting with potentialities; their conceivable use is not confined to their original function (I confess that I have used a credit card to force a door). And these evolutionary shifts in function can be as quirky and unpredictable as the potentials of complexity are vast. It happens all the time; it virtually defines the wondrous indefiniteness of evolution.

The balancing fins of fish become the propulsive limbs of terrestrial vertebrates, while the propulsive tail becomes an organ that often aids in balance. The bone that suspended an ancestral fish's upper jaw to its cranium becomes the bone that transmits sound to the ears of reptiles. Two bones that articulated the jaws of that reptile then become the other two sound-transmitting bones of the mammalian middle ear. When we see how beautifully our hammer, anvil, and stirrup function in hearing, who would imagine that one bone first suspended jaw to cranium, while two others articulated the jaws? And a mode of sex determination that may first have aided a lonely female colonizer apparently became the basis of social systems only rivaled by our own for their complexity.

As we probe deeper and further back, the unpredictabilities mount. I discussed the quirkiness of a functional shift toward support of sociality by a feature probably evolved as an aid to colonization. But what about the larger reason for our imperfect and unpredictable world: structural limits imposed by features evolved for other reasons? Social systems like those of ants and bees might be of enormous advantage to hosts of other creatures. But perhaps they do not evolve simply because it is so difficult to get them started in diploid organisms (only termites have succeeded), while haplodiploid hymenopterans develop them again and again. And going one step further back (I promise to stop here), what about constraints on the evolution of haplodiploidy itself? Haplodiploidy might be a wonderful adaptation to a host of ecologies, but it cannot always be easily evolved.

Assuming that haplodiploids generally arise from diploids, what does it take to turn a haploid creature into a male? Under some systems of diploid sex determination, male haploids cannot easily evolve. A haploid human would not be male, for a single X chromosome induces the development of a sterile female. But other diploids have a so-called XX-XO system of sex determination, in which females have two X chromosomes and males have a single X with no accompanying Y (but all other chromosomes in pairs). In such systems, a haploid organism might develop easily and directly into a male. (The XX-XO system is not an absolute prerequisite for haplodiploidy as more complex modifications also can produce male haploids from other modes of diploid sex determination.)

In short, modes of sex determination limit haplodiploidy, haplodiploidy limits sociality, and sociality requires a quirky shift in the adaptive significance of haplodiploidy. What order can we find in evolution amidst such a crazy quilt of limits to a sensibly perfect and predictable world?

Some might be tempted to read an almost mystical message into this theme—that evolution imposes an ineffable unknowability upon nature. I would strongly reject such an implication: knowledge and prediction are different phenomena. Others might try to read a sad or pessimistic message—that evolution isn't a very advanced science or isn't a science at all if it can't predict the course of an imperfect world. Again, I would reject any such reading of my words about constraint and quirky functional shift.

The problem lies with our simplistic and stereotyped view of science as a monolithic phenomenon based on regularity, repetition, and ability to predict the future. Sciences that deal with objects less complex and less historically bound than life may follow this formula. Hydrogen and oxygen, mixed in a certain way, make water today, made water billions of years ago, and presumably will make water for a long time to come. Same water, same chemical composition. No indication of time, no constraints imposed by a history of previous change.

Organisms, on the other hand, are directed and limited by their past. They must remain imperfect in their form and function, and to that extent unpredictable, since they are not optimal machines. We cannot know their future with certainty if only because a myriad of quirky functional shifts lie within the capacity of any feature, however well adapted it may be to a present role.

The science of complex historical objects is a different, not a lesser, enterprise. It seeks to explain the past, not predict the future. It searches for principles and regularities underlying the uniqueness of each species and interaction, while treasuring that irreducible uniqueness and describing all its glory. Notions of science must bend (and expand) to accommodate life. The art of the soluble, Peter Medawar's definition of science, must not become short-sighted, for life is long.

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

For more detailed information, visit our Custom Banking offices on Fifth, Madison, or Park Avenues, Sutton Place, Avenue of the Americas, or Wall Street. Or call Ms. Mary Ellen O'Brien, Vice President, (212) 536-4841. Member FDIC.

CUSTOM
BANKING

THE
BANK OF
NEW
YORK

Discover the banking service customized to meet the very special needs of the most affluent and demanding people in the world.

Dating Very Old Objects

Long-lived radioactive isotopes are the best clocks yet found for ascertaining the ages of very old terrestrial and extraterrestrial rocks

by George W. Wetherill

The ordinary human concept of time is a subjective one, dependent on the ordering of everyday events combined with the feeling of duration and of the interval between two experiences. This subjective time is notoriously unreliable; time passes much more quickly at a lively party than in a dentist's chair. In order to overcome this difficulty, the individual sense of the flow of time was regimented and collectivized by the use of such clocks as the rising and setting of the sun, moon, and stars; the alternation of the seasons; the tolling of the bell in a church tower; and more recently, by the changing digits displayed outside savings and loan institutions. The dates in history books represent merely the record of the human experience of time maintained by our ancestors.

In contrast, the geologist is trained to think of time in a different way, as a flow of events independent of human perception. Unaccustomed to this difference, the layman often finds it absurd or amusing to hear a geologist speak casually of millions or billions of years. Terrestrial rocks display the record of ancient, unwitnessed events, such as the flow of glaciers, the emergence and flooding of continental land masses, and the collision of entire continents to form great mountain ranges. For more than two hundred years a combination of common sense and physical principles has enabled geologists to build up a chronology of evolutionary events that occurred on the earth long before the advent of the human species. These methods have made it possible to place in temporal sequence the relatively recent ice ages, the rise and fall of the great reptiles, the splitting of Europe from North America, the dawn of abundant terrestrial life, and even the sequence of events preserved in earlier rocks devoid of fossils.

But this sequence is merely an ordered list. It does not involve the kind of time that appears as an independent variable in the basic laws of physics and chemistry. That is the kind of "time" that Newton groped to define: "absolute, true, and mathematical time, of itself, and from its own nature, [it] flows equably without relation to anything external. . . ." Time also appears in the equations of Einstein and of quantum physics. In order to properly describe the earth as the physical and chemical machine that it is, a way had to be developed to relate the events recorded in the earth's rocks to natural, time-dependent physical processes.

There were many early attempts to do this. For example, in 1900 John Joly, an Irish geologist and physicist, combined measurements of the erosion rates of rocks with the accumulation of salt dissolved in the ocean, and estimated the age of the earth to be 90 million years. At the end of the nineteenth century, Lord Kelvin, the great mathematician, physicist, and engineer, calculated the age of the earth as 100 million years, by combining measurements of the increase in temperature in deep mines with the physics of heat conduction. Although these estimates were in rather good agreement with one another, we now know they were incorrect.

Astronomers recognize that even excellent clocks, such as those based on the motion of the earth and moon, fail to keep perfect Newtonian time; small corrections must be introduced to take account of such phenomena as the slowing down of the earth's rotation by tidal friction. The "clocks" used by the earth scientists mentioned above were much more crude. The erosion rates used by Joly are variable and poorly known, and dissolved salt can be separated from seawater in ocean spray and by sedimentation. The earth's interior is not simply cooling, as Kelvin assumed, but is also being heated by natural radioactivity, and heat transport in the earth is primarily accomplished, not by thermal conductivity, but by the slow convective creep of apparently solid rocks.

Radioactivity, first discovered in 1896 by Henri Becquerel, French physicist and Nobel laureate, now provides a superior geologic clock, one intrinsically much more accurate than even the rotation of the earth or the recently developed quartz clocks. The use of radioactivity for dating rocks and minerals is not new; a paper containing a reasonably correct list of ages based on the quantity of lead formed in minerals rich in uranium and thorium (some forms of which transform into lead) was published in 1907 by Bertram B. Boltwood, a chemist and physicist at Yale University. A similar use of the accumulation of helium in radioactive minerals was accomplished a few years earlier by the British physicist Ernest Rutherford. In the early twentieth century, however, there was no firm reason for believing that the accumulation of the products of radioactive substances could provide reliable geologic ages. We now know that natural radioactivity is controlled by the binding energy of the atomic nucleus, an energy so large that the effects of terrestrial temperatures and pressures on the rate of radioactive transformation will be negligible. We also know that parent and daughter elements consist of different isotopes, and use of these elements for dating requires not only chemical analysis but isotopic analysis as well. It is remarkable that Boltwood's 1907 ages were as good as they were considering that the nucleus of the atom was not discovered until 1912, and the first separation of isotopes, by the British physicist Joseph J. Thomson, was not accomplished until 1913.

As a result of many major advances in

t. Andrews
Ewan Macdonald
Greengables
Gleneagles
Auchterarder
Perthshire
PRIORITY MAIL
"White Label"
DEWAR'S
BLENDED SCOTCH WHISKY
100% SCOTCH WHISKIES
PRODUCT OF SCOTLAND
BLENDED AND BOTTLED BY
John Dewar & Sons Ltd
PERTH SCOTLAND
750 ml
(25.4 FL OZ)
86.8° PROOF

WHEN Postman Mackenzie of Perthshire, Scotland, makes a delivery . . . it's always special. The good things in life stay that way.

Preferred for smoothness, Dewar's® never varies.

Authentic.
The Dewar Highlander

BLENDED SCOTCH WHISKY • 86.8 PROOF • © 1982 SCHENLEY IMPORTS CO., N.Y., N.Y.

nuclear physics and astrophysics, the conceptual basis for radioactive dating is now clear. The remaining difficulties are more practical ones. All but a very minor fraction of the chemical elements now found on the earth and other planets were formed in the interior of stars before the formation of the sun and the solar system. These elements, or more properly, their individual isotopes, were formed by a complex variety of processes in stars of various sizes. The newly synthesized elements were returned to the interstellar medium by the mechanisms through which stars lose mass. The most dramatic of these mechanisms is that of the supernovae, in which the bulk of a star's mass is ejected into interstellar space in a single violent explosion.

Most of the isotopes supplied to the interstellar medium are stable and constitute ordinary nonradioactive matter. Short-lived radioactive isotopes are also produced by the processes, but these soon transform into their stable daughter isotopes and simply increase somewhat the quantity of these stable isotopes. In addition, some radioactive isotopes that are almost stable are produced, but their rate of radioactive transformation is so slow that significant quantities of these primordial isotopes have survived from the time they were formed down to the present.

Some of these naturally occurring long-lived radioisotopes decay so slowly that their half-life, that is, the time required for half of an original quantity of the parent isotope to be transformed into the daughter isotope, is considerably longer than the 4.5 billion year age of the earth, and most of the original quantities of these long-lived isotopes remain. Examples are thorium-232, with a half-life of 14 billion years; rubidium-87, with a half-life of 49 billion years; and samarium-147, with a half-life of 11 billion years. In other cases, although the half-life is comparable to, or less than, the age of the earth, a significant quantity of the original isotope still remains.

The shortest-lived primordial isotope used for age determination is uranium-235, with a half-life of 704 million years. Only about one percent of the uranium-235 present at the time the earth was formed still exists; almost all of it has been transformed into the stable isotope of lead, lead-207. Radioisotopes that are significantly shorter lived than uranium-235, even if they were present in appreciable quantities at the time the earth was formed, have been reduced to quantities so small that they are detectable only with great difficulty, if at all. Examples of these "extinct radioactivities" are plutonium-244, with a half-life of 82 million years, and iodine-129, with a half-life of 17 million years.

Extinct radioactive isotopes are used for dating the time differences between events that took place very early in the history of the solar system. Even shorter-lived radioisotopes, such as carbon-14, with a half-life of 5,730 years, and beryllium-10, with a half-life of 1.5 million years, are of great geologic and archeological importance, but the isotopes used were not produced in the primordial events that produced such nearly stable, long-lived isotopes as thorium-232, uranium-238, and uranium-235. Carbon-14, for example, is continuously produced in the atmosphere through the capture of neutrons produced by cosmic-ray bombardment of atmospheric nitrogen-14. These short-lived radioisotopes are used for dating relatively recent geologic events and archeological artifacts.

The decay of rubidium-87 into strontium-87 can be taken as an example of the general principles involved in using a long-lived isotope to date old terrestrial and extraterrestrial rocks. Although in detail each of the various isotopic techniques involves somewhat different assumptions, all of these methods have much in common. In the case of rubidium-87 and strontium-87, the nuclei of the two isotopes differ only in that the rubidium nucleus contains 37 protons and 50 neutrons, while the strontium nucleus contains 38 protons and 49 neutrons. The rubidium-87 nucleus has a slightly greater mass, and as a consequence energy is released when its extra neutron is transformed into a proton and it becomes strontium-87. This change is called beta decay. The transformation of the neutron into the proton is accompanied by the emission of a negative electron, named the beta-particle, and a neutral neutrino. The half-life for this transformation, or beta decay, as mentioned earlier, is 49 billion years.

The radioactive isotope rubidium-87 is one of two naturally occurring rubidium isotopes; the other is the stable isotope rubidium-85. During the formation of the solar system, the isotopes produced in presolar times were well mixed. Although some small isotopic differences can be found in meteorites, for all practical purposes the earth's initial isotopic composition of rubidium can be considered to be uniform.

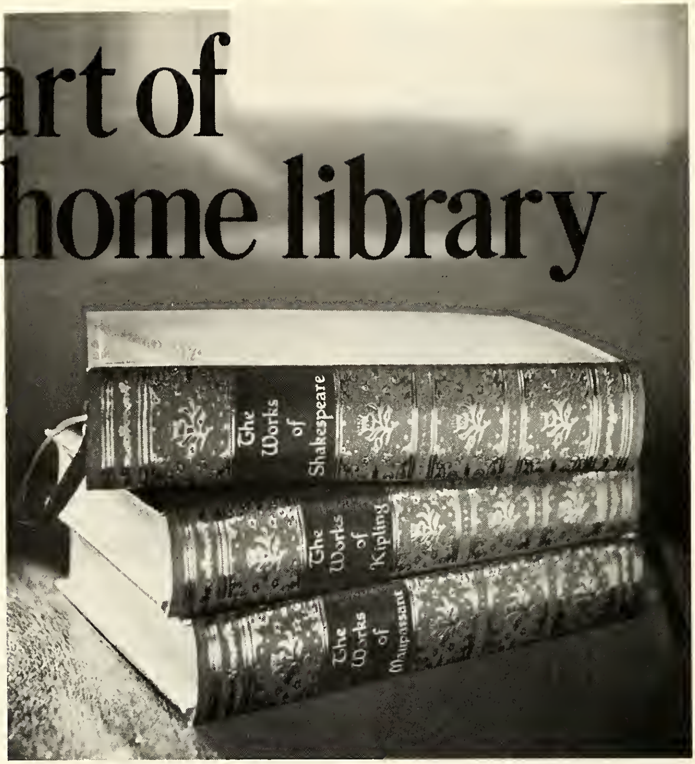
At the time of the earth's formation, 4.5 billion years ago, for every rubidium-85 atom there were 0.412 rubidium-87 atoms. At a later time, 3 billion years ago, the ratio had decreased to 0.403. At the present time, the ratio has decreased to 0.386. At every particular time in the past the ratio of rubidium-85 to rubidium-87 had a fixed value characteristic of that time. If at the present time we extract rubidium from an ancient volcanic rock, the ratio of rubidium-87 to rubidium-85 will be 0.386. There wouldn't be any point even measuring this, since the ratio is the same in all terrestrial rocks. If, on the other hand, we had some way to determine what the ratio of rubidium-87 to rubidium-85 was at the time the rock was formed by freezing of lava flowing from an ancient volcano, then that would be worthwhile. For example, if that ratio were known to have been 0.403, we would know the rock was 3 billion years old because, as mentioned earlier, 0.403 was the value of the rubidium-87 to rubidium-85 ratio in *all* rocks 3 billion years ago.

Fortunately, there is a practical way to learn the value of the ratio at the time the rock was formed. The reason there was more rubidium-87 in the rock when it was formed than there is now is that since that time some of the rubidium-87 has decayed into strontium-87. If, for the moment, we assume that there wasn't any strontium-87 in the rock when it was formed, then all we have to do is measure the quantity of strontium-87 in the rock now, add it to the quantity of rubidium-87 in the rock now, divide that figure by the quantity of rubidium-85 now in the rock, and we have the ratio we need in order to know the rock's age. There are some natural minerals, the lithium mica lepidolite, for example, for which it is actually sometimes valid to assume that the initial strontium-87 content was so small it can be neglected. The first rubidium-strontium ages were measured using lepidolite and the results were fairly accurate.

Lepidolite is, however, a special case. In the formation of lepidolite the chemical properties of rubidium are such that it is readily accepted in the mineral's crystal structure, whereas strontium is almost completely rejected. In the crystallization of an ordinary volcanic rock, some enrichment of rubidium relative to strontium occurs, but in a much less dramatic way. With an ordinary rock one cannot assume that all the strontium-87 was produced by the decay of the rubidium-87 present in the rock when it was formed. If we want to calculate the initial ratio of rubidium-87 to rubidium-85, we must first subtract the strontium-87 that was present when the rock was formed.

There is a way to do this. Suppose we had a second ordinary volcanic rock, formed from the same lava pool as the first. Suppose further that the mineral composition of the second rock was such

The start of a fine home library



Let us send you, for the token price of only $1 each, three books that have served as cornerstones in many a fine home library.

The complete works of Shakespeare

This beautiful 1300-page volume contains every word Shakespeare ever wrote. All 37 of his comedies, tragedies, and historical dramas including Hamlet, Romeo and Juliet, Macbeth, etc. Also all of his poems and sonnets.

The works of Kipling

Actually eight books in one. A complete novel and 139 stories, ballads and verses loved the world over, including Mandalay, Gunga Din, The Phantom Rickshaw, etc.

The works of De Maupassant

128 matchless tales by the acknowledged master of the short story. Every story complete and unexpurgated: The Diamond Necklace, A Piece of String, The Will, etc.

Each volume is clothed in a handsomely-tooled binding of antique ecru with both the elegant look and feel of leather.

You will enjoy reading these books, just as millions before you have. Your friends will admire them, perhaps even envy you for owning them. And your children will gain a real advantage with books like these always close at hand.

We offer you three books of this calibre for only $1 each to introduce you to our new Golden Giants Series. We think you will be impressed. And we hope you will want to own others in the Series, as they become available, including:

Hugo. 36 complete works including Hunchback of Notre Dame, A Woman of the Streets, The Souls.

Regularly $29.67. Now only $1 each.

Stevenson. 39 novels, stories, poems. Treasure Island, Dr. Jekyll and Mr. Hyde, Kidnaped, etc.

Doyle. All the best of Sherlock Holmes—The Sign of The Four, Red-Headed League, plus other works.

Poe. 91 works: Annabel Lee, The Raven, The Gold Bug, Murders in the Rue Morgue, etc.

The full series will also include the works of Cellini, Wilde, Ibsen, Browning, Longfellow, Emerson, Dostoevsky, Byron and many others.

Normally, you would expect to pay $12 each or more for deluxe editions of books like these. But our direct-to-the-public method of book distribution (which we have specialized in for over 50 years) lets us make these volumes available for only $10.35 each, plus shipping.

Send no money now. Simply mail coupon to get your first three volumes for only $1 each, plus shipping, and to reserve the privilege of examining future volumes as they come from the press.

You will receive advance description of all upcoming volumes. You may reject any book before or after you receive it. And you may cancel your reservation any time you wish.

Mail coupon to: Black's Readers Service, Roslyn, New York 11576.

PUBLISHED BY
WALTER J. BLACK, INC.
ESTABLISHED 1923

Black's Readers Service

ROSLYN, NEW YORK 11576

Please enroll me as a subscriber and send me at once SHAKESPEARE, KIPLING and DE MAUPASSANT I enclose *no money now*. After a week's examination, I will either keep my books and pay $3 (plus shipping) or return them.

Also reserve for me additional volumes in the Golden Giants of Literature Series. As a subscriber, I will get advance descriptions of future volumes. For each volume I choose, I will pay just $10.35 (plus shipping). I may return any book, for full credit within 21 days and I may cancel my reservation at any time.

MR./MRS./MS. ______________________
(Please print plainly) **2-ZP**

ADDRESS ______________________
G02D7T

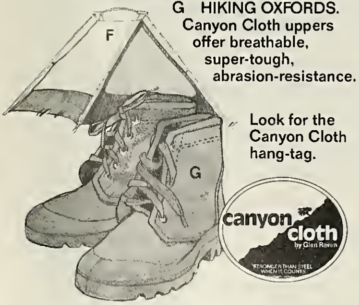
CITY &
STATE ______________ ZIP ________

Note: Subscribers accepted in U.S.A. and Canada only, offer slightly different in Canada

canyon cloth
A
B
C
D
E

STRONGER THAN STEEL
WHEN IT COUNTS!

The performance of outdoor gear depends on the quality of the fabric it's made of. Canyon Cloth, of DuPont Type 66 nylon, is lb. for lb. stronger than steel.
A DOME TENTS are exceptionally strong and stable with lightweight, coated Canyon Cloth for sidewalls and heavier, breathable types for tops.
B PARKAS with lightweight Canyon Cloth shells move easily on the trail, are rugged and close to indestructible.
C BACKPACKS come in as many styles as there are trails to follow with Canyon Cloth meeting every requirement.
D BELTPACKS of Canyon Cloth are flexible—unbeatable for light loads.
E DUFFLES & TOTES take a beating. Canyon Cloth's rugged construction shrugs off wear.
F BACKPACKING TENTS of Canyon Cloth are compact, lightweight.
G HIKING OXFORDS. Canyon Cloth uppers offer breathable, super-tough, abrasion-resistance.



F
G
canyon cloth
by Glen Raven
STRONGER THAN STEEL WHEN IT COUNTS
Look for the Canyon Cloth hang-tag.

that strontium rather than rubidium was enriched and as a result the quantity of strontium-87 produced by the decay of rubidium-87 in this second rock was negligible. One's first thought might be to use the quantity of strontium-87 in the second rock as an estimate of the initial quantity of strontium-87 in the first rock, and subtract this to find out how much strontium-87 was produced by the decay of the rubidium. This, however, wouldn't work; the fact that the second rock was enriched in strontium would cause its strontium concentration to be completely atypical and useless for this purpose.

The right way to use the strontium in the second rock is to make use of the fact that strontium has three other stable isotopes in addition to strontium-87; namely, strontium-84, strontium-86, and strontium-88. Unlike strontium-87, these isotopes are not the daughters of long-lived radioactive parents but any one of them can be used to find the correct initial concentration of strontium in the first rock. Suppose we choose the strontium-86 isotope. Because both rocks in our hypothetical example crystallized from the same well-mixed lava pool at the same time, the initial value of the *ratio* of strontium-87 to

Parent-Daughter Isotopic Pairs

Parent	Daughter	Parent Half-life (Years)	Applications
Beryllium-10 (Be)	Boron-10 (B)	1.5 million	Oceanic sediments, soils, and cosmic-ray exposure of meteorites
Carbon-14 (C)	Nitrogen-14 (N)	5,730	Archeological specimens
Iodine-129 (I)	Xenon-129 (Xe)	17 million	Duration of formation of the solar system
Lutetium-176 (Lu)	Hafnium-176 (Hf)	35 billion	Rare earth minerals and basaltic meteorites
Plutonium-244 (Pu)	Xenon-136, 134, 132 (Xe)	82 million	Very early events (older than 4 billion years) in solar system history
Potassium-40 (K)	Argon-40 (Ar)	1.25 billion	Rocks of all ages, down to those as young as about 0.5 million years, and meteorites
Rhenium-187 (Re)	Osmium-187 (Os)	43 billion	Iron meteorites and very old molybdenite
Rubidium-87 (Rb)	Strontium-87 (Sr)	49 billion	Rocks and meteorites of all ages, including those as young as 10 million years
Samarium-147 (Sm)	Neodymium-143 (Nd)	11 billion	Precambrian rocks and meteorites older than 600 million years
Thorium-232 (Th)	A chain of 9 radioactive daughters ending in stable lead-208 (Pb)	14 billion	Rocks and meteorites of all ages, including those as young as 20 million years
Uranium-235 (U)	A chain of 10 radioactive daughters ending in stable lead-207 (Pb)	704 million	Same as thorium-232
Uranium-238 (U)	A chain of 13 radioactive daughters ending in stable lead-206 (Pb)	4.5 billion	Same as thorium-232

strontium-86 was the same in both rocks. Because the production of strontium-87 in the second rock was negligible, its present-day ratio is equal to this initial ratio. This ratio can be measured. By determining the concentration of strontium-86 in the first rock and multiplying by the common initial strontium-87 to strontium-86 ratio found from the second rock, the initial quantity of strontium-87 in the first rock is found. This initial quantity is then subtracted from the total amount of strontium-87 in the first rock to find the quantity of strontium-87 produced by the decay of rubidium-87. It isn't even necessary that the second rock be enriched in strontium relative to rubidium. The knowledge that both rocks formed at the same time from the same lava pool but with different ratios of strontium to rubidium can be used to set up simultaneous linear algebraic equations for both unknown quantities—the age of the rocks and their common initial strontium-87 to strontium-86 ratio. In practice, in determining the age of a given rock specimen, more measurements are usually made than needed through the use of "cogenetic" rocks and minerals, that is, rocks formed at the same time from the same material.

The foregoing discussion not only illustrates the basic principles of radiometric dating but can also be used to sharpen our definition of what is meant by the "age" of a rock. In the example chosen, the rock was volcanic and crystallized from a lava. The essential circumstances that made this event datable were that two or more rocks were formed at the same time, they differed from the chemical composition of the lava from which they crystallized by being enriched or depleted in rubidium and strontium during the crystallization process, and they all had the same strontium-87 to strontium-86 ratio at the time they were formed.

The crystallization of a volcanic rock is not the only geologic event that can be dated in this way. Metamorphic rocks can be dated by the same methods. These are rocks formed from other rocks under extreme heat and pressure deep within the earth. As a result of the metamorphism, new minerals are formed that contain quantities of rubidium and strontium different from those in the original rock. If the metamorphism is sufficiently intense, all of the strontium initially present is mixed well enough to cause its strontium-87 to strontium-86 composition to be uniform. The effect of the metamorphism is to mimic exactly the circumstances that existed when the volcanic rocks crystallized from a pool of melted lava. In the case of metamorphic rocks, however, the age is not the time the original rock crystallized but the time of metamorphism. Sedimentary rocks—compacted accumulations of small particles of mineral matter usually deposited by water—may also have a uniform initial strontium-87 to strontium-86 composition.

Ages, therefore, cannot be found by chemical and isotopic analyses alone. The geologic and geochemical context in which the sample was formed must be well understood if one is to have any idea what meaning, if any, should be attached to a calculated age. Another possibility is that the conditions necessary to establish an age of the material under study may not exist at all. Under those circumstances, the rocks are said to constitute an "open system." Enrichments and depletions of rubidium and strontium may have occurred as a result of natural geochemical processes, but the necessary uniformity of the isotopic composition may never have been achieved. In that case formal calculation of an age from the analytical data will merely provide a meaningless value.

Because nature has generously supplied us with a number of long-lived parent-daughter isotope pairs in addition to rubidium and strontium, it is usually possible to at least say whether or not a meaningful age is being measured, and if it is, the nature of the event that is being dated, that is, whether the sample is volcanic, metamorphic, or sedimentary. When the same age, within acceptably small experimental errors, is obtained with several different isotopic pairs, there is good reason to believe that the age is meaningful. The circumstances that may cause a formally calculated age to be meaningless would seldom affect several isotopic systems in the exact way necessary to result in the same erroneous result. As already mentioned, additional information obtained by studying the rocks in the field and under the microscope is necessary to determine whether the age represents original crystallization, subsequent metamorphism, sedimentary deposition, or some other geologic event. The identification of the type of event dated is also reinforced because the various isotopic pairs used tend to respond differently to these alternative datable events. For example, the commonly used potassium-argon system, and to a lesser extent the rubidium-strontium system, tend to respond readily to subsequent metamorphism. In contrast, a samarium-neodymium pair is quite insensitive to metamorphism and is therefore very useful in "seeing through" subsequent metamorphic episodes to learn the age of original crystallization.

Join "Wild Kingdom's" Marlin Perkins on the 5-Plus Star Vistafjord's Around Africa Cruise.

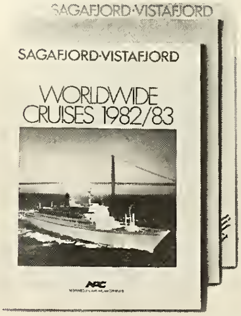
If you're looking for a travel adventure, the three handsome brochures offered below could make all the difference.

The difference between routine itineraries and the incomparable array of itineraries offered on our cruises and cruise/safaris to Africa and India.

The difference between an ordinary ship and the Norwegian-registered Vistafjord, judged best by *Fielding's Worldwide Guide to Cruises.*

And on our December 18 Around Africa Cruise, you'll be joined by "Wild Kingdom's" Marlin Perkins.

To receive your free brochures even sooner, call 800-221-2400. In New York State, 212-422-3905.



NORWEGIAN AMERICAN CRUISES
NAC
29 Broadway, New York,
New York 10006

Please rush me your free Africa/India cruise and cruise/safari brochures.

NAME
STREET
CITY STATE ZIP
PHONE NUMBER
TRAVEL AGENT

NH982

Beyond the general considerations given above, the only general rule regarding choice of a dating method is appreciation of the need for redundancy. More than one isotopic pair should be employed, a number of cogenetic rocks should be measured, the size of the rock samples should be varied, and both whole rock samples and separated minerals should be measured. When all this is done, the situation will probably appear more complex than if only a few measurements had been made. But with all these data, it is usually possible to unravel the complexity of the rocks under study or at least avoid being tricked into an incorrect interpretation. Practical considerations also dictate the choice of a dating method. For example, some rocks and minerals contain such a low concentration of the parent isotope or such a high initial concentration of the daughter isotope that it may be impossible to measure accurately the growth of the radiogenic daughter isotope since the original rock was formed. An even more practical consideration is that the standards in this field are now so high that few laboratories are equipped to use all the known methods of dating. The answer to this problem is likely to be more collaboration, rather than bigger and more expensive laboratories.

During the last thirty years the use of these methods has, among other accomplishments, revolutionized our understanding of Precambrian geology, established the time scale for igneous activity on the moon, and determined the age of the solar system. At one time the only datable rocks were those rich in uranium: They were dated and then geologists tried, often successfully, to attach some geologic meaning to the result. Now the geologic questions—how was the rock formed and when—are asked first and then field samples are used to find the answers.

A simplified description of what takes place is that geologists send rock samples to the laboratory. The samples are ground up, put through some chemical reactions, analyzed in a mass spectrometer, and then a computer prints out the sample's age. When simplified in this way the procedure sounds very routine. To some extent, achievement of such a routine technique is what geochronologists have been striving for, but as soon as the goal appears within grasp, some greater challenge always seems to appear. There is more to the work than this prosaic description indicates. That is why this work has always been a rewarding struggle rather than a bore.

A good example of the challenge is the dating of lunar rocks. During the mid-1960s dating of ancient terrestrial rocks had become fairly routine and geologists anticipated that the lunar samples promised by President Kennedy by the end of the decade could be dated in the same way. Particular importance was attached to the solidified lavas that covered the dark "mare" regions of the moon. These contained the clue to the moon's thermal history. Estimates of the age of the same mare surfaces, based on counting craters on telescopic photographs, ranged from 20 million to 4 billion years. Dating these rocks directly was clearly a matter of highest importance. However, something of a shock went through the geochronological community in 1967 when the unmanned *Surveyor* spacecraft telemetered back to Earth the first chemical analyses of these lunar rocks. Measurements showed that the volcanic rocks were basalts containing large amounts of calcium and quite small concentrations of potassium. Geochemical considerations indicated the likelihood that such rocks would contain so much original strontium and so little rubidium that their enrichment in radiogenic strontium would be too slight to permit accurate age measurements. When *Apollo 11* brought back the first samples from Mare Tranquillitatis this was exactly what was found. During the two intervening years, however, geophysicist Gerald J. Wasserburg and geochemist Dimitri A. Papanastassiou at CalTech developed new mass spectrometric techniques that improved the accuracy of strontium isotope ratio measurements by more than a factor of ten. During the same period Grenville Turner, a geochemist at Sheffield University in England, made major improvements in the use of potassium-argon isotopes.

As a result of these advances, and because of excellent preservation of the basalts on the airless, waterless moon, the lunar basalts were dated more accurately than any terrestrial rocks had been. For example, ten basalts from the *Apollo 17* site in Mare Serenitatis yielded tightly clustered rubidium-87–strontium-87 ages ranging from 3.56 to 3.76 billion years and argon ages ranging from 3.69 to 3.84 billion years. The average rubidium-strontium age of these rocks was 3.67 billion years and the average argon age was 3.71 billion years.

The same improvements in mass spectrometric techniques that provided those more accurate strontium measurements were soon applied elsewhere to other problems. Probably the most important of these developments was the introduction of samarium-147–neodymium-143 dating by geochemist Guenther Lugmair at the University of California at San Diego. The possibility of using this isotopic pair had been known for several decades, but the expected enrichments in neodymium were too small to be measured accurately enough to be usable. All this was changed with the new improvements in mass spectrometry.

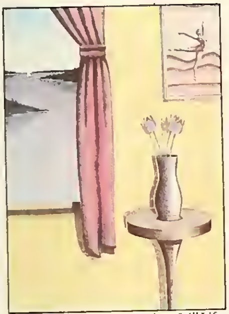
The first rock to be dated by the samarium-neodymium technique was the basaltic meteorite Juvinas, which had been found in 1821 in France. Meteorites of this kind resemble the lunar mare basalts rather closely, and dating them accurately presented similar problems. Lugmair's samarium-neodymium age of 4.56 ± .08 billion years for this meteorite showed that melting and production of basaltic lavas occurred on the small asteroidal bodies from which these basaltic meteorites are derived at about the beginning of the solar system. A similar age of 4.50 ± .07 billion years has been measured on the Juvinas meteorite by the rubidium-strontium method, and 4.56 ± .01 billion years was derived using uranium-lead methods. The samarium-neodymium dating method has subsequently been used to measure the age of a number of lunar and terrestrial rocks as well. For example, the *Apollo 17* mare basalts discussed earlier have been dated by this method at 3.73 billion years, in excellent agreement with the rubidium-strontium and argon ages.

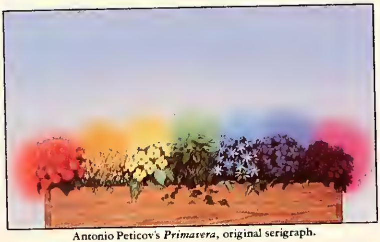
The most important fairly recent discovery in terrestrial geochronology has been the identification in western Greenland of the oldest-known rocks on the earth. These rocks were dated at 3.68 billion years by geochemist Steven Moorbath and his colleagues at Oxford University in 1971. This result has subsequently been confirmed by samarium-neodymium measurements that yielded 3.77 billion years. In contrast to the lunar and meteoritic basalts discussed earlier, the principal problem in identifying and dating very old terrestrial rocks is not technical but geologic. The earth is such an active planet that preservation of ancient rocks through episodes of mountain building, erosion, metamorphism, and weathering is improbable.

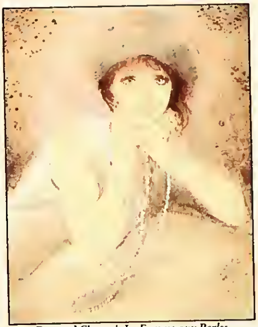
Geochronologists are certain that at one time there were rocks on the earth considerably older than those dated in Greenland. Some of these may possibly still be found. And by means of the samarium-neodymium approach, or perhaps another technique yet to be developed, those rocks when found may be accurately dated.

George W. Wetherill, a geophysicist, is director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, Washington, D.C.

Original. Exclusive. Authenticated. Yours for less than $200.


Jack Eaker's *Northbeast Harbour Still Life*, original lithograph. Signed limited edition of 195.


Antonio Peticov's *Primavera*, original serigraph. Signed limited edition of 195.


Bernard Charoy's *La Femme aux Perles*, original lithograph. Signed limited edition of 250.

Picture the pleasure and satisfaction of owning original work by artists represented in the great museums and galleries of the world.

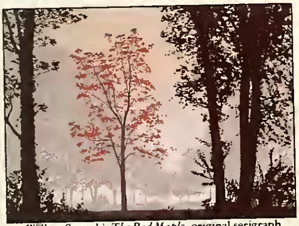
The Original Print Collectors Group offers you an outstanding selection of work by newcomers and by major artists like Calder. Chagall. Miró. Picasso. Vasarely. Etchings, engravings, lithographs, woodcuts and silkscreen prints, signed and numbered by the artists themselves.

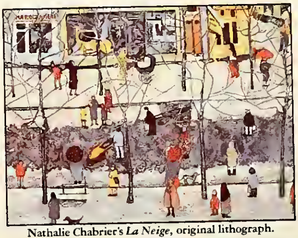
We choose prints for value as well as beauty. So we offer very limited editions, usually between 100 and 300 impressions. We never re-issue an edition. This makes your print truly rare and exclusive.

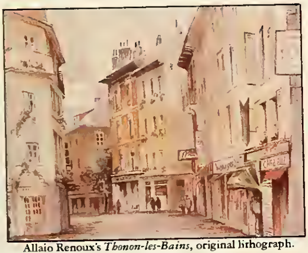
Every print comes with a Certificate of Authenticity, your assurance (for appraisal or resale purposes) that you own a bona fide, signed, limited edition original. You also get a full money-back guarantee.

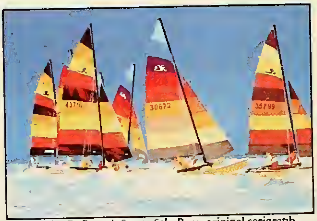
As a member of the Group, you can own a fine contemporary print with a custom-designed museum-quality frame for as little as $200.

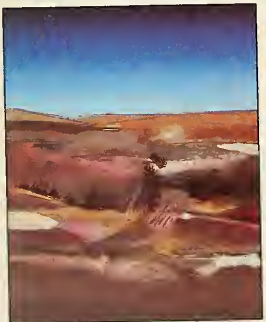
For even more information, without obligation, send in the coupon today. We'll send you a beautiful color catalog—free. Find out about *all* the rewards of owning original art.

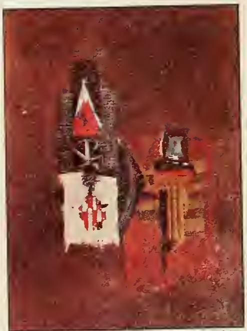

Wilbur Streech's *The Red Maple*, original serigraph. Signed limited edition of 250.


Nathalie Chabrier's *La Neige*, original lithograph. Signed limited edition of 250.


Allaio Renoux's *Thonon-les-Bains*, original lithograph. Signed limited edition of 175.


Charles Bofinger's *Start of the Race*, original serigraph. Signed limited edition of 275.


Marlene Lenker's *Autumn Prelude*, original lithograph. Signed limited edition of 250.


Johnny Friedlaender's *Scherzo*, original etching with aquatint. Signed limited edition of 95.

Visit our new gallery located at 215 Lexington Avenue,
Mon–Fri, 9–5 PM. Telephone: 212-685-9400 Ext: 35

Original print collectors group, Ltd.
215 LEXINGTON AVE., DEPT. NH-45, NEW YORK 10016

PLEASE SEND ME YOUR FREE COLOR CATALOGUE WITHOUT OBLIGATION.

NAME ____________________
(PLEASE PRINT)

ADDRESS ____________________

CITY ______________ ST ______ ZIP ______

© 1982 OPCG, LTD

What Hath Night to Do With Sleep?

Modern society is setting its own pace

by Martin C. Moore-Ede

Three centuries ago, when John Milton asked, "What hath night to do with sleep?" the answer seemed obvious. People's daily timetable was preset by the earth's twenty-four-hour period of rotation. Unless you were a Galileo, a night watchman, or a shepherd tending your flock, there was little else to do at night but sleep. But that has all changed. One-fifth of American workers now have nocturnal jobs, either continuously or on a rotating schedule. Often they are forced to sleep during the day rather than the night, rendering Milton's rhetorical question more than academic.

If any one person is to blame, it is Thomas Edison, inventor of the electric light bulb. While he did not originate the phrase "let there be light," his innovation freed mankind from the smoke and eyestrain of candles and gas lamps. But for all things that give us more control over our environment, there are costs to be borne, as well as benefits to be gained.

The introduction of electric light, combined with the ever increasing capital costs of industrial investment, provided the impetus to staff industrial facilities around the clock. For instance, a blast furnace may take several days to heat up, so it makes sense to use it continuously once it is going. But the real escalation in round-the-clock work came with World War II. The unending demand for more ammunition and guns at the front led to the widespread introduction of shift work in armament factories on both sides of the conflict. Since that war, we have, as a society, increasingly come to ignore the day–night cycle of the natural world around us. Concurrently, we have been blessed (or cursed) with the jet airplane, which can whisk us across multiple time zones and confront our bodies with daylight when it ought to be night.

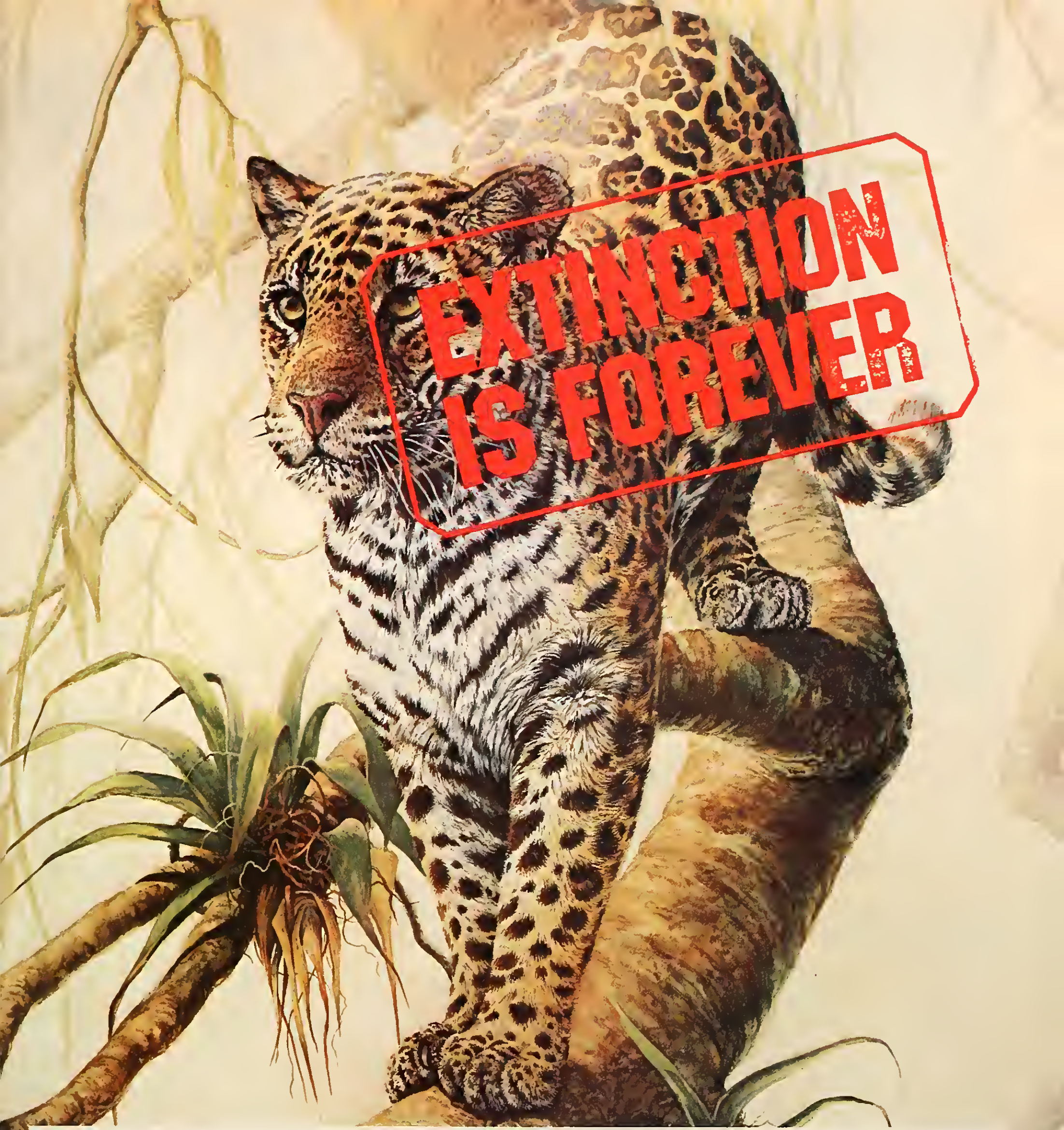
The consequences for quiet slumber have been disastrous. The bleary-eyed trans-Atlantic vacationer, rewarded with the sights and sounds of Paris or London, can tolerate the disruptive effects of sleep loss. But the shift workers who have just rotated their schedule from the day to the night shift, and who will change it again a week later, receive little compensation for the disruption of sleep and the dyspepsia that they will endure. Fully 80 percent of such workers report problems with insomnia, fatigue, and malaise—a chronic fate for those who run the industrial plants, emergency and security services, and all the other enterprises we take for granted twenty-four hours a day. Yet this is the direction in which our society is moving. Responding to a market need, American television networks are introducing twenty-four-hour programming. A recent survey has shown there are 4.9 million TV sets turned on between 2:00 and 5:00 A.M., a seemingly improbable statistic until one realizes the vast number of people swept up by this "temporal revolution."

The modern world has placed our bodies in a conflict, and we are only just beginning to realize the consequences. Insects and mice subjected to a weekly shift of the day–night cycle show 5 to 20 percent decreases in their life span. No studies have yet been conducted in humans to investigate the long-term effects of extended exposure to shift work, but the fatigue, gastrointestinal disturbances, and loss of alertness among shift workers have significant immediate costs for their health and their productivity. Shift workers also face considerable stress in their social and family life.

Sleep disruption and fatigue in shift workers have consequences even for those who do not work at night. The Federal Aviation Administration rules on rest time and duty time do not take into account the twenty-four-hour sleep–wake cycle. A pilot can be scheduled to flip-flop between daytime and nighttime flying, as long as he has a few hours off after each episode of flying. Such erratic schedules, coupled with shifts across time zones, contribute significantly to pilot fatigue, which is increasingly being recognized as an important cause of accidents. Errors by shift workers in other industries may have even more widespread consequences. While a direct relationship cannot be proved, the Three Mile Island nuclear power plant accident occurred at 4:00 A.M., with a crew that had just rotated on to the night schedule. This is at the minimum point of the daily cycle of alertness, when errors of omission and slowness in responding to warning signals are most likely to occur.

The human body cannot be treated like a machine that can function equally well at any time of day or night. The reasons lie back in our evolution. We carry within us models of the earth's rotation and the day–night cycle under which our species evolved. Internal circadian, or approximately twenty-four-hour, pacemakers lie within our brains precisely scheduling our physiology and behavior in synchrony with the day–night cycle. Two major pacemakers appear to be responsible for the timing of sleep. One lies within the suprachiasmatic nuclei, a pair of small (less than 1 mm) clusters of ten thousand nerve cells each that lie in the hypothalamus just above the optic chiasm, the place where the optic nerves cross over on their way back from the eyes to the visual cortices of the brain. In the absence of external time cues, this pacemaker tends to have a period of about twenty-five hours, but under normal conditions it is reset by about an hour each day by the light–dark cycle, via a specialized bundle of nerves (the retino-hypothalamic tract) passing back from the eyes. The other pacemaker, which we refer to as X (its exact location is not yet known), accounts for the rhythms, such as body temperature and plasma cortisol levels, that persist even in the absence of the suprachiasmatic nuclei. (The direct evidence for the existence of this pacemaker comes from animal experiments in which the suprachiasmatic nuclei are destroyed.) X has its own natural periodicity, longer than twenty-four hours but somewhat shorter than that of the suprachiasmatic nuclei.

Together these two circadian pacemakers determine the timing and duration of sleep. The suprachiasmatic nuclei play a key role in the consolidation of sleep into a single episode initiated at a regular time of day. The X pacemaker appears to be particularly responsible for arousal from sleep and thus is important in determining the duration of sleep once it is initiated. The most convenient marker for the X



Some day within our lifetime, in the South American jungle, one jaguar may die that is the last of its kind on earth. And a whole species will have vanished, as surely and as irretrievably as the dinosaurs.

It's an appalling idea. But extinction is forever, and acting too late is the same as not acting at all.

Fortunately there is an organization that is acting now. It's called RARE.

They're working now toward the survival of species endangered by the expanding population of Latin America. But their cause and their efforts embrace the whole world.

We at the Gulf Oil Corporation applaud and support the intent and activities of RARE. We want to make sure you know something about them, and about the tremendous job they are doing.

For more information about RARE and their work, write to: RARE, 950 Third Ave., New York, NY 10022.

Gulf Oil Corporation

© 1982 Gulf Oil Corporation

Painting by Bonnie L. Marris

Where in the world can you save money on a tropical vacation?

Now a vacation in peaceful Costa Rica is a better value because your dollar exchanges for twice as much as last year. Get away to our unspoiled beauty and year-round spring climate without blowing a bundle. For information write the Costa Rica Tourist Board, 200 S.E. First St., Miami, FL or call **800-327-7700**, (**800-432-7502** in FL), the airline that's happy to please you...LACSA.

LACSA
The Airline of Costa Rica

COSTA RICA
we have so much to share

Omaha Steaks International®

Try a little tenderness

Now there's an easy way to make those special occasions truly memorable! Just try a little tenderness.

Candlelight . . . soft music . . . and . . . magnificient, aged Omaha Steaks. Tender, luscious, corn-fed beef with extraordinary flavor. Perfect.

Experts prepare each filet from the finest tenderloins. Their artistry in cutting and aging is your assurance of the utmost in enjoyment.

Your steaks will arrive frozen in a reusable picnic cooler. We guarantee your complete satisfaction. Order today!

Six 6 oz. Filet Mignons, 1¼" thick (reg. $47.50) $29.50
(plus $3.00 shipping/handling)

Save $18.00! Limit 2 per customer. Valid in 48 states until Sep. 30, 1982.

James Beard, noted food authority, says: "Omaha Steaks are everything I expect a good steak to be."

FREE WITH YOUR ORDER . . . The Omaha Steaks Cookbook, filled with easy-to-follow cooking instruction, helpful storing and serving hints, and recipes by James Beard, World Famous Food Authority. Also, a colorful catalog of gourmet treats with a 10% discount on your first catalog order. **Write for FREE catalog and 10% discount coupon only.**

Omaha Steaks International®
Use major credit card and
Call Free 1-800-228-9055
In Nebraska phone 0-402-391-3660 collect.
or write to: Dept. 1788, P.O. Box 3300 • Omaha, Nebraska 68103

pacemaker is the circadian rhythm in deep-body temperature, which reaches a minimum in the early hours of the morning, rises in anticipation of waking, and then peaks late in the afternoon, two or so degrees Fahrenheit higher than the nocturnal trough. The pacemaker apparently initiates the body "warm-up" in advance of our waking, and at a certain point in the temperature climb, our arousal from sleep is triggered.

This circadian temperature rhythm, or more precisely the internal pacemaker that drives it, is hard to budge from its natural periodicity and timing. If we stay awake all night and then attempt to fall asleep, the temperature rhythm hardly shifts at all, and the arousal phase occurs within an hour or two of its usual time, truncating our sleep. The worker who has just rotated to the night shift and come home at seven or eight in the morning may find it hard to go to sleep on the rising slope of his body temperature rhythm. If he stays awake until the late afternoon, however, he will find that sleep will come more easily, and indeed, if he is not aroused by family or alarm clock, he will sleep all through the evening and night and not spontaneously awaken until the next morning upswing of the body temperature rhythm.

The internal timing system can be reset, however. The X pacemaker (and body temperature rhythm) will gradually adjust to a new environmental time schedule, moving an hour or so a day. Thus it takes several days for the trans-Atlantic traveler and the shift worker to adjust. Until that time the arousal phase will intrude into their attempted sleep with consequent insomnia and fatigue.

We must become aware of these periodic features of our constitution that suited us so well in the environment of our origins but that handicap us in the world we have created. While we cannot retreat to the "good old days" when all human activities were scheduled from sunrise to sunset, we can design schedules for the shift worker that take account of the limited adaptability of the body's circadian pacemakers. In a future article, I will describe how the scientific study of internal circadian regulators has advanced over the years and suggest some of these practical applications.

Martin C. Moore-Ede, professor in the Department of Physiology and Biophysics of the Harvard Medical School, is coauthor of The Clocks That Time Us: Physiology of the Circadian Timing System, *published by Harvard University Press.*

An Outstanding Opportunity for Collectors of Western Art

THE FIFTH IN A SERIES OF MUSEUM QUALITY BRONZE REPLICAS

"THE MOUNTAIN MAN" HAS BEEN SELECTED AS THE OFFICIAL COMMEMORATIVE BRONZE FOR THE INAUGURATION OF THE 40TH PRESIDENT OF THE UNITED STATES, RONALD REAGAN.

The original American "rugged individualist," the mountain man was immortalized by Frederic Remington in this striking bronze, which Remington completed in 1903.

More than any Western character, the mountain man typified the courage and daring of the first Western explorers.

A SOLITARY FIGURE IN AN UNCHARTED WILDERNESS

Alone for months at a time, the mountain men were the first Americans to explore the forest trails, the mountain passes, the rivers and lakes of the vast expanse of unsettled land, long before the coming of the '49ers, the cowboys, and the early railroads.

REMINGTON'S REALISM AT ITS BEST

The Mountain Man is one of Remington's most detailed bronzes. Every item of the mountain man's equipment is accurately depicted — his rifle, his traps, his blanket roll, knife, his fur hat and buckskins.

UNSURPASSED QUALITY IS GUARANTEED

The Mountain Man, in a strictly limited edition of 1,000, is cast by the lost wax process. Each bronze is foundry marked, numbered and dated. Modeled from 13 of the approximately 80 original casts Remington produced, the replica has been approved by the Director of The Buffalo Bill Historical Center. Each bronze is accompanied by a Certificate of Ownership signed by the Director, and your purchase is registered in your name in the Center's archives.

A REMARKABLE VALUE IN TODAY'S INFLATED ART MARKET

At a time when bronzes of lesser size and quality are priced from $3,000 up, this edition is offered to collectors at $1,875. We urge you to reserve your bronze now — there is a waiting list for the first three limited edition Remington bronzes that have been issued, and it is anticipated that the demand for this fine replica will also exceed the number of bronzes available.

GUARANTEED REPURCHASE AGREEMENT

Museum Collections Inc., unconditionally guarantees to repurchase your bronze at the issue price of $1,875 any time within one year of your purchase.

TO ORDER, CALL TOLL FREE...

800-243-4492, or write: Elizabeth Krieger, Director, Museum Collections Inc., Dept. H 50, 140 Greenwich Ave., Greenwich, Ct. 06830 for brochure. You may pay by check, money order or major credit card. Optional five month payment plan available.

Frederic Remington's "The Mountain Man"

Issued in cooperation with The Buffalo Bill Historical Center, Cody, Wyoming, in an edition of 1000, the replica is hand finished, foundry marked, numbered and dated. It is approximately 22 inches high with American Walnut base, three-fourths the size of the Remington original.

museum
collections

Better Than Jogging

NordicTrack

Jarless Total Body Cardiovascular Exerciser
Duplicates X-C Skiing for the Best Motion in Fitness

Highly Effective and Pleasant To Use
The enjoyable sport of cross-country skiing is often cited by physiologists as the most perfect form of cardiovascular exercise for both men and women. Its smooth, fluid, total body motion uniformly exercises more muscles and higher heart rates seem easier to attain than when jogging or cycling. NordicTrack closely simulates the pleasant X-C skiing motion and provides the same cardiovascular endurance-building benefits — right in the convenience of your home. Makes a year round, consistent exercise program easily attainable. Eliminates the usual barriers of time, weather, chance of injury, etc. Also highly effective for weight control.

Better Than Running
NordicTrack gives you a more complete work out — conditions both upper body and lower body muscles at the same time. Fluid, jarless motion will not cause joint or back pains as jogging or running often does.

Better Than Exercise Bikes
NordicTrack's stand-up skiing motion more uniformly exercises large leg muscles and also adds important upper body exercise. Higher pulse rates, necessary for building fitness, seem easier to attain because the work is shared by more muscle mass. The NordicTrack also keeps more muscles in tone.

Even Better Than Swimming
NordicTrack more effectively exercises the largest muscles in the body, those located in the legs and buttocks. These muscles' main function is to lift and propel the body in the standing position. However, when swimming, the body is supported by the water, thus preventing these muscles from being effectively exercised. The stand up exercising position on the NordicTrack very effectively exercises these muscles.

A Proven, High Quality Durable Product
Ruggedly constructed, NordicTrack is quiet, motorless and folds compactly for storage. Separately adjustable arm and leg resistances. NordicTrack is in its 5th year of production and is used in thousands of homes and many companies. We manufacture and sell direct. Our No-Risk 15 day trial guarantee shows our confidence in your being pleased with the performance and quality of the NordicTrack.

For more information, call or write
PSI 124 L Columbia ct. Chaska, MN 55318
toll free 1-800-328-5888 **8 – 5 Mon – Fri**
Minnesota 612-448-6987

Hole in Space

A large void has been found in the universe where several thousand galaxies had been expected to exist

by Robert P. Kirshner

Like the fifteenth-century navigators, astronomers today are embarked on voyages of exploration, charting unknown regions. The aim of this adventure is to bring back not gold or spices or silks but something more valuable: a map of the universe that will tell of its origin, its texture, and its fate. One recent probe of the distribution of galaxies, islands of stars in the ocean of space, has revealed a vast void: an empty region large enough to contain a billion galaxies like our own Milky Way. This void, a billion light-years beyond the constellation Böotes, provides clues to the conditions shortly after the Big Bang that began the universe about ten billion years ago. It leads to improved understanding of how the galaxies condensed early in the history of time and indicates that our expanding universe may coast infinitely into the future.

The void in Böotes is just one aspect of a deep mystery about the universe, which, although it appears to be uniform on very large scales, is inhomogeneous on small scales. When we look at any region in detail, we see that the universe is lumpy, full of galaxies, groups of galaxies, and the spaces between. When these local details are suppressed by averaging over a large volume, we expect one region of the universe to be the same as any other. Similarly, a piece of silk is composed of threads and gaps at microscopic scales, but looks smooth on the scale of a few inches.

Evidence that the universe is homogeneous comes from observing the most distant sources: both radio emission from remote galaxies and quasars and the pervasive glow of the Big Bang itself are smoothly distributed. On a scale of a billion light-years, the universe is as smooth as silk; more detailed investigation shows the warp and woof of the cosmic fabric.

The lumps and gaps in the distribution of galaxies are particularly interesting. Our Milky Way galaxy, with 100 billion stars spread out over a disk 100,000 light-years in diameter, is a dense lump compared with the average density in the universe. Our cosmic neighbors, the Local Group of galaxies, are separated by distances on the order of one million light-years, yet this is also a dense aggregate. Even larger lumps in the universe are known: thousands of galaxies swarm together in great clusters of galaxies and the clusters themselves may be gathered into still larger superclusters.

We are faced with an interesting puzzle —while the universe appears to be homogeneous on the largest scales, it shows inhomogeneous lumps on every small scale. An important observational issue is to map the universe on large enough scales to see where the lumpiness fades into uniformity, and an important theoretical problem is to understand the origin of dense regions in a generally smooth universe.

In general terms, it is not hard to see how density inhomogeneities could grow to make the galaxies and clusters of galaxies we see today. Small fluctuations in the early universe would create places of higher and lower density. Because of their gravitation, the dense regions would attract more material and increase their contrast with the surrounding regions. But important details of this picture remain obscure because the era of galaxy formation took place so long ago that we cannot observe any galaxies in the processes of condensing.

We don't know for certain where the original fluctuations came from and we don't know whether the early seeds were large regions that fragmented to make galaxies or whether small, galaxy-sized lumps formed first and gathered together to make larger systems. Even though we cannot observe these processes directly, we can make progress on these questions by adopting the methods of paleontologists. They cannot study live dinosaurs, but they can use the fossils the animals leave behind. Astronomers cannot see the galaxies forming, but we can study the present distribution of galaxies as a fossil of that inaccessible era ten billion years ago.

I have been engaged in one recent effort to chart the present distribution of galaxies over large distances and to shed a little light on the shadowy realm of forming galaxies, working in cooperation with Gus Oemler at Yale, Paul Schechter of the Kitt Peak National Observatory, and Steve Shectman at the Mount Wilson and Las Campanas Observatories. We selected a few small regions of the sky and made a three-dimensional chart of every galaxy brighter than a selected limit. The limit was set faint enough so that the typical galaxy in our sample was 20,000 times fainter than the faintest stars you can see with your naked eye, and at a distance of roughly one billion light-years.

Our aim was to find out three things related to the formation of galaxies. First, we wanted to measure how many galaxies there are of each size. Some galaxies have fewer stars than the Milky Way, some many more. Since different-size galaxies grew from different-size lumps in the early universe, this would provide a clue to the conditions that prevailed when the galaxies were forming.

A second aim was to measure the total density of galaxies. The universe is expanding now, coasting along since the Big Bang, but that expansion could eventually be stopped if there is enough mass so that gravitation brakes the motion. A central question in cosmology is whether the universe will expand forever or collapse in the distant future.

A third aspect of our investigation proved to be the most interesting. We wanted to measure the clustering of galaxies on very large scales. These present-day fluctuations in density presumably had their origin in ancient variations, just as lumps in pancakes come from lumps in the batter.

The way to study the distribution of galaxies is to chart their positions in three-dimensional space. The problem is that the distance to a galaxy is not easy to measure directly. In our investigations, as in most extragalactic studies, we used the observed expansion of the universe to measure the distance to each galaxy. Because

The very first African arts to attract the attention of travelers and historians were music and dance. A shield from ancient Greece depicts an African trumpet player. African sculpture was not appreciated until the end of the 19th century.

Bargain for a beautiful Dan mask in the morning and enjoy a delicious martini in the evening. The excitement and sophistication of West Africa is waiting for you.

Part of the fun of West Africa is bargaining. The rules for success: 1. Start at half the price you're willing to pay. 2. Never hurry. 3. Always keep your sense of humor.

Masks & martinis.

The great wealth of West African art is just seven hours away on a luxurious, non-stop Air Afrique jet from JFK. For more information call your Travel Agent or your nearest Air Afrique/Air France ticket office.

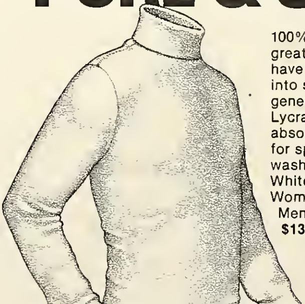
Much of the great African art comes from West Africa, and the best way to get there is Air Afrique. We have the most complete schedule of flights between West African cities, New York, Europe and the rest of Africa.

If you like hotels with air conditioning and swimming pools, you will find a hotel to your liking in virtually every West African capital city.

AIR AFRIQUE

Africa begins with Air Afrique.
And it's just seven hours to the New Sun...
West Africa.

PURE & SIMPLE



100% cotton turtlenecks fit as great as they feel. Shoulder seams have 2-way stretch to spring back into shape. Ribbed cuffs and generous fold-over collar are Lycra® -reinforced. Soft and absorbent, these knits are perfect for sports or leisure wear. Machine washable. **Colors:** Camel, Navy, White. Men's also in Black, Women's also in Red. **Sizes:** Men's S/M/L/XL. Women's S/M/L. **$13.95** postpaid.

Order Today!
Money Back Guarantee!

Here is my check or money order for $______
(Add sales tax for shipment into CA, CO, D.C., IL, MI, PA, WA).
Please charge my ☐ MasterCard ☐ VISA
☐ American Express Good Thru______
Card No. ______
#7149 Men's 100% Cotton Turtleneck
Color ______ Size______
#7236 Women's 100% Cotton Turtleneck
Color ______ Size______
☐ **Send me your FREE color catalog of quality outdoor apparel and equipment.**

Name______
Address______
City______
State ______ Zip ______

STORES IN: Seattle • San Francisco • Philadelphia • Boston • Detroit • Minneapolis • Chicago • Washington, D.C.

Eddie Bauer®

Dept. DNH, Fifth & Union, Seattle, WA 98124

the universe is growing larger, the distance between our Milky Way galaxy and any of the galaxies in our study is increasing. That means that each of the galaxies is moving away from us, and the more distant a galaxy is, the faster it is receding. By measuring the velocity of a galaxy, then, we have an index of its distance, and we can plot it on our three-dimensional map.

The velocity measurements are time consuming and especially slow for the faint and distant galaxies that make this sample unique. To gather enough light requires a big collecting area. Data for this sample have been gathered over the last five years with some of the biggest and best-equipped telescopes: the 52-inch reflector at the McGraw-Hill Observatory in Arizona, the 50-inch and the 84-inch telescopes at Kitt Peak National Observatory in Arizona, the superb 100-inch telescope at Las Campanas in Chile, the exotic Multi-Mirror Telescope at Mount Hopkins, Arizona, and the granddaddy of them all, the 200-inch Hale Telescope at Palomar Mountain, California.

It would be a good idea to survey the entire sky to a given depth—and that approach has been very productive. But for the depth we were plumbing, an all-sky survey would involve velocity measurements for a million galaxies. Instead we took a few deep samples, for a total of a few hundred galaxies, in the hope that this would give a fair picture of the large-scale structure in the universe.

We derived three main results from this investigation. First, we found that the distribution of galaxy sizes in our distant sample was essentially identical to the distribution found near the Milky Way, and is also very similar to the distribution of sizes found in the great clusters of galaxies, where the present density of galaxies is much higher. This suggests that the distribution of galaxy sizes is set by a process that acted long ago, and was not sensitive to the galaxy density. It may mean that the galaxies formed before the clusters did.

A second result is that although the fluctuations in galaxy density are large, the average value that we find corresponds to a low-density universe—one that will expand forever. This means that our sun, and all the stars in the universe, will have time to burn up their nuclear fuel and fade out, leaving a very cold, dark, and dull, but still expanding universe 100 billion years from now.

The third result is the discovery of a very large empty volume in our survey—the void in Böotes. In the Northern Hemisphere, our sample consisted of three fields forming a triangle in the sky in the general direction of the constellation Böotes and its bright star, Arcturus, with each leg of the triangle about 35° long. To visualize this you could hold a large dinner plate at arm's length—it would block out a circle of about 35° diameter. In each of these three fields we found nearby galaxies (a mere 500 million light-years away), and distant galaxies (over 1.2 billion light-years away), but a large and clear gap in the interval of 750 to 1,100 million light-years. This gap of roughly 300 million light-years is astonishingly large. In our sample, which covers only a small fraction of the volume in this region, we expected to find about 25 galaxies in this interval. We found only one.

If the gap covers the triangle with our survey fields at the corners, then the volume of the void is large enough to contain a billion galaxies the size of the Milky Way. Of course, galaxies are not packed shoulder to shoulder—we would expect the whole volume to have several thousand galaxies if the density were the same in the void as in a more typical region. Could there be some way to avoid the startling conclusion that thousands of galaxies are missing? There are several possibilities, but none of them seems very likely. First, of course, our sample is small so we have probed only a very small fraction of the volume in the void. Our method is a little like poking knitting needles into a big pumpkin. There *could* be something solid hiding in there that we have missed. More extensive surveys covering the interior of the triangle are under way to check on this possibility. While it is correct to be cautious in a field where the data are scarce, the data are so hard to get that we don't want to ignore what this sample tells us.

Another possibility is that the void is not really a void, but contains unusually faint galaxies. This in itself would be extraordinary—it would require that this giant region had very unusual conditions for the formation of galaxies.

If the void is just what it appears to be—a huge vacant region—it requires an explanation. One possibility is that it is just a gap left behind when the galaxies gathered into clusters. The problem with that picture is the sheer size of the region involved. Can chance fluctuation, followed by gravitational attraction, conspire to create such a giant empty volume? In order to find out, we need a more detailed comparison of observations and models to check whether the observed distribution of hole sizes corresponds to this idea.

Another notion is that structure on the scale of a few hundred million light-years may have been "built in" by fluctuations on this scale in the early universe. For example, if large segments of the universe separated from the general expansion and then began to fragment into galaxies, the result might have been huge superclusters of galaxies and giant voids between.

One interesting sidelight of this picture is that the properties of the tiny and elusive subatomic particle called the neutrino might be relevant to these considerations of the largest structures. Some recent experiments indicate that the neutrino, formerly thought to have no mass, might have a very small mass after all. If these results are verified, then it could be that neutrinos are an important agent in forming the very large-scale distribution of matter. For example, since the neutrinos would have very little interaction with matter or light, they are unlikely to cluster on any but the largest scales. Then these ghostly particles could dominate the clustering of matter and determine the large-scale structure of the universe. Of course, studying the clustering of galaxies is the very worst possible way to measure the mass of a particle that is available in terrestrial laboratories, so we will just have to wait for more decisive experiments, but the possibility of an intimate link between the smallest objects and the largest is an exciting prospect.

The void is an empty region, a kind of blank. It should not be confused with a black hole, which is a very dense region with so much matter that not even light can escape its dreadful gravitational grip. A black hole with the mass of a thousand galaxies would be only a few light-years across. Indeed, the void is exactly the opposite—instead of being small and dense, it is extremely large, a few hundred million light-years across, and empty.

The study that revealed the void probes the texture of the universe. Instead of being a smooth ocean or one evenly dotted with islands, we find great archipelagoes with vast lonely stretches between, somewhat like the Pacific Ocean. Our voyage of exploration is just beginning—more detailed work may show what role is played by gravitation, what features are due to the built-in conditions in the universe, and may illustrate deep connections between the incredibly small objects of particle physics and the structure of the universe. The giant void in Böotes shows that there will be surprises and possibly treasures in charting the unknown reaches of the universe.

Robert P. Kirshner is a professor of astronomy at the University of Michigan and director of the McGraw-Hill Observatory.

ORDER FORM
AMERICAN EAGLE
by Guy Coheleach
National Audubon Society
P.O. Box 212
Chadds Ford, PA 19317

☐ Please accept my commission for "AMERICAN EAGLE" to be hand-signed, numbered and framed expressly for me. The issue price is $300, plus my state sales tax and $6.95 for shipping and handling.
I need send no money now. I will be billed when my Color Gravure is ready to be sent.

Valid only if postmarked by December 31, 1982
Limit: One American Eagle per person

© 1982 N.A.S.

A special invitation

☎ You may enter a charge card order 24 hours a day, 7 days a week
Toll free: 800-345-8600 Ext. 30
In PA call: 800-662-5180 Ext. 30

IF ORDERING BY MAIL:

Name ______________________________

Address ______________________________

City ______________________________

State ____________________ Zip __________

Signature ______________________________
(all commissions subject to acceptance)

Please note that we cannot ship to P.O. Boxes
Please allow 8-10 weeks for shipment

4

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT 3651 CHADDS FORD,PA.

POSTAGE WILL BE PAID BY ADRESSEE

NATIONAL AUDUBON SOCIETY
P.O. Box 212
Chadds Ford, PA 19317

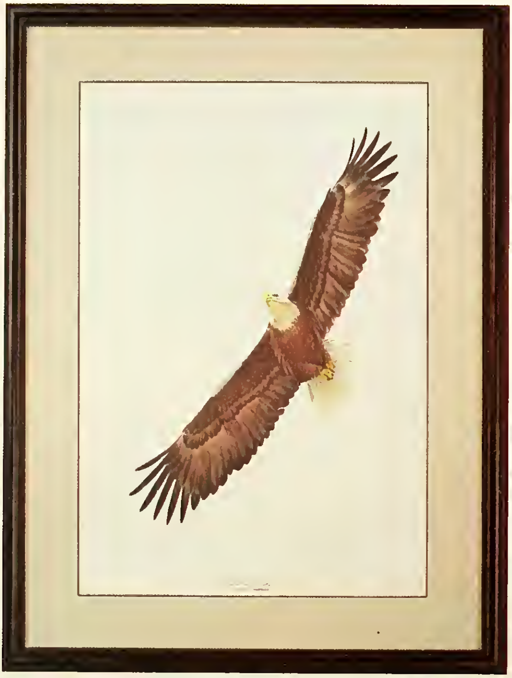
In Commemoration of the 200th Anniversary of the Eagle as the Official Symbol of the United States of America

The National Audubon Society Presents

American Eagle

By Guy Coheleach

The Society's Official 1982 Fine Art Issue



- **An Original Color Gravure**
- **Exceptionally Large 26½ x 35½ Framed Size**
- **Hand Signed by the Artist**
- **A Registered Limited Edition**
- **Your order must be entered by December 31, 1982**

PRESIDENT RONALD REAGAN has proclaimed 1982 as "THE YEAR OF THE EAGLE", Officially honoring the 200th anniversary of the eagle as our symbol of strength, independence, and freedom.

THE NATIONAL AUDUBON SOCIETY has appropriately selected the eagle as the subject of The Society's Official 1982 Fine Art Issue, entitled "AMERICAN EAGLE". And, to create this historic issue The Society commissioned the Internationally famous American artist, Guy Coheleach, whose wildlife paintings have hung in the White House and have been exhibited world-wide, including Moscow and Peking. His works have been Vice Presidential gifts to visiting heads of state.

EACH "AMERICAN EAGLE" is an original Color Gravure individually pulled from six different copper plates. And, to capture all the imposing character of the American Eagle, the framed Color Gravure will be exceptionally large - 26½ x 35½. It is noteworthy that the time-honored tradition of copper plate printing was used to produce the works of John James Audubon over 150 years ago. "AMERICAN EAGLE" is the first and only original Color Gravure ever issued by the National Audubon Society, and as such will be especially valued by knowledgeable collectors.

ISSUED IN A LIMITED EDITION. "AMERICAN EAGLE" is being made available by direct order only. It will not be offered for original sale through any stores or art galleries. Furthermore, it will be issued only during the officially proclaimed year of the Eagle - 1982. After that the original copper plates will be cancelled and retired to the archives of the National Audubon Society. None of these original Color Gravures will ever be created again.

HAND SIGNED AND SERIALLY NUMBERED. Mr. Coheleach will personally inspect each Color Gravure, and when completely satisfied he will pencil sign the work. As further assurance of its quality and Official status, each Color Gravure will be embossed with the Seal of the National Audubon Society and will be accompanied by a certificate of authenticity, signed by the President of the National Audubon Society. Finally, each "AMERICAN EAGLE" will bear a Registration number so that subscribers can forever identify their Color Gravure as their own. In keeping with its importance "AMERICAN EAGLE" will be professionally matted and mounted in a hand-crafted walnut and gold toned frame to protect and beautifully display the work. This special museum quality frame, in a traditional 18th Century design, was selected to complement every home or office decor.

ENTER YOUR ORDER BY DECEMBER 31, 1982. The subscription period for "American Eagle" will expire on December 31, the end of the 200th Anniversary year of the Eagle's adoption as our National Symbol. Orders postmarked after that date will regretably be refused. Subscriptions will be filled on a first come first serve basis and earliest orders will receive the lowest registration numbers. Therefore, it is important that your subscription form be returned as soon as possible, and in any case no later than December 31.

ADVANCE ORDER FORM

AMERICAN EAGLE

by Guy Coheleach

National Audubon Society
P.O. Box 212, Chadds Ford, Pa. 19317

Please accept my commission for "AMERICAN EAGLE" to be hand-signed, numbered and framed expressly for me. The issue price is $300.*

I need send no money now. I will be billed when my Color Gravure is ready to be sent.

**Plus my state sales tax and $6.95 for shipping and handling.*

Valid only if postmarked by December 31, 1982

Limit: One American Eagle per person

Mr.
Mrs.
Miss. ____________________

please print clearly

Address ____________________

City ____________________

State, Zip ____________________

Signature ____________________

©1982 NAS

All Commissions are subject to acceptance

Photographs by David Stein

Gin suckles her daughter, Gina, while her presumed niece, Floret, snuggles against her. Gin has not been a tolerant mother, and she has pushed her various offspring to independence at an early age.

Mother Baboon

Some mothers cut the apron strings quickly, others keep the maternal ties as long as practical. What is best for a young baboon depends on its mother's social standing

by Joan Luft and Jeanne Altmann

The savanna bakes in the harsh light of the long dry season and the air is still with the heat of afternoon. In the distance, groves of acacia trees seem to waver in the dusty air. A high-pitched squeaking, like an inexpert bowing of violin strings, comes from the stand of tall grass where a group of baboons are feeding, laboriously pulling the tender inner stems of the grass out of the tough outer sheaths.

The period from July to October is a critical time of the year for many animals of the East African grasslands. Most water holes are dry, the grasses are dead, and few shrubs bear fruit. At this time the baboons have to work hard for their living. They travel from morning to night in search of scattered patches of food, and they spend a long time processing the foods they do find. By the end of the day their fur is full of powdery savanna dust, and the younger animals' hands are sore from digging grass corms.

One by one the baboons emerge from the clump of grass where they have been feeding. Except for the youngest members of the group, the baboons are almost the same yellow brown as the landscape—the immense East African monochrome of dry grass and bare ground, of sun and dust. The half-dozen infants born earlier in the year have black coats, wrinkled pink faces and hands, and oversized, bright pink ears that stick straight out.

As the group moves, ten-month-old Putz jumps on and off his mother's back. He blocks her way as she walks, and when she stops at another grass clump, he clings to her and interferes with her feeding. She moves him gently aside. A few minutes later, when Putz again approaches her, she stops feeding and lets him suckle. Giles—born the previous August on the same day as Putz—also tries to ride on his mother, Gin. Far less gentle than Putz's mother, Gin shoves Giles away at once and nips at him. He throws himself down, screaming and thrashing on the ground like any human two-year-old in a tantrum. From time to time he glances at Gin to see how she will react, but she is indifferent and goes on with her foraging. Finally, Giles turns to a nearby male—a formidable-looking animal, twice the size of the adult female, with a heavy mane and fanglike canine teeth. The male carries the exhausted infant to the baboons' resting-place in the shade of the acacia trees.

The forty-five baboons that have been scattered across the savanna all afternoon now gather in the damp green hollow under the trees. They drink at a shallow pool, mothers suckle their infants, and the older animals sit together in groups of two or three, eyes half-closed, grooming each other's fur or nibbling at leaves in the head-high tangle of bushes near the water.

Scar, an older female that has been lagging behind the group, limps slowly toward the grove. For the last few hours she has been walking three-legged, supporting her day-old infant with one hand. She flops down in the shade with a glazed look in her eyes. Gradually, other baboons—mostly adult females and a few juveniles—gather around her, first staring at the new infant, then sniffing and pulling at it. Scar turns away uneasily, keeping tight hold of the little black infant even as another female pulls at its leg. When a male baboon comes over, the curious group drifts away, and Scar relaxes again, letting the male groom her fur as she dozes.

Dry though the savanna is—and in some places it is only bare tawny powder with animal trails scrawled white across it—water for its vast animal population is never far away. The foothills of Kilimanjaro rise behind the acacia trees, sharp and blue in the dry air; and "Kili" itself, cloud wrapped and immense, towers above them. The runoff from its snows flows under the savanna, so near the surface that the little hollows in the ground become pools and large hollows become lakes or swamps bright with water birds. The pools are also breeding grounds for malaria-carrying mosquitces, which give the tall acacias near the water their common name of "fever trees."

Many of the trees in the grove have died—drowned at the roots in wet years, poisoned by salts in the soil, or pulled to pieces by hungry elephants. Gray, fallen tree skeletons, stumps, and scattered limbs lie in the shadow of the grove. As the infant baboons recover their energy, they make the hollow a playground. Dead trees

are to climb and jump on; stumps are the place to play king of the mountain; the springy, tangled thickets of *Salvadora persica* are a maze to duck through or a trampoline to bounce on. Giles runs by with a bright feather in his teeth, like a flamenco dancer with a rose, and Putz comes running after him, eager to take the feather away.

The evening settles in (near 6:00 P.M. year-round, here close to the equator), and one by one the mothers collect their infants. The baboons climb into the crowns of three close-set fever trees, where they will prop themselves in forked branches to sleep through the night—with luck, undisturbed by the leopards that hunt in these groves, gliding from branch to branch. The two observers who have been following the baboons all day, walking with them from grass clump to *Salvadora* thicket, pack up their notebooks and their dust-covered recording gear and head back to the base camp and their own, somewhat less precarious beds.

At the whitewashed mud house that is the home of the Amboseli National Park Baboon Project, the observers go on with their work, tinkering with equipment and checking through recently acquired data. Their own supper has been much quicker than the baboons'; the evening wash water has already gone out the back door and given the grass there a few more days' lease on life. In the dark, elephants intent on their supper lumber through the yard, and as one chews loudly on the fresh grass under the window, an observer writes to the Baboon Project's American base. "Hurray, hurray, Scar finally had her kid! . . . It looks good except for some trouble clinging. Scar looks awful. Perhaps she's getting too old for this mother business. . . . The rain gauge was knocked over three times by elephants. I am holding my breath now, as it is still standing after being replaced the last time."

The rainfall records, only occasionally interrupted by elephants, are part of a much larger body of data on Scar and her companions and their environment. In the last ten years, this group of forty-odd baboons in Kenya's Amboseli National Park has become one of the most intensively studied wild primate societies in the world. It is called Alto's Group, after the regal old baboon who stood at the top of the female dominance hierarchy (the monkey equivalent of a pecking order) for many years. Alto died in 1976, but her daughter Spot has Alto's place at the top of the hierarchy, followed by Alto's other daughters and granddaughters. Researchers at the American bases, at the University of Chicago and Cornell University, celebrating the completion of a new book or article or the initiation of a new project phase, still occasionally drink a toast "to Alto—without whom none of this would be possible."

"This" includes detailed records on the baboons' environment, group membership, and behavior; on temperature, rainfall, and plant growth; on births, deaths, and such behaviors as mating, aggression, feeding, grooming, and encounters with other baboon groups and other animal species. The records on this group were begun in 1971 by Stuart and Jeanne Altmann of the University of Chicago and by Glenn Hausfater, now of Cornell University. They and a succession of their colleagues and students have kept up systematic observations and, in addition, have conducted studies aimed at specific questions about the baboons' life: the relationship of dominance rank and reproductive success, the acquisition of rank by maturing baboons, the development of foraging skills in older infants, and the like.

One of the chief focuses of the Amboseli project in recent years has been the study of mother–infant relationships. Like other monkeys and apes—and for that matter, like the humans who watch them—baboons begin life with a long period of

Left: On her mother's death in 1976, Spot "inherited" the top ranking in the female dominance hierarchy of the Amboseli troop. Because of her social station, she has not had to be particularly attentive toward her infants. Other members of the troop can be depended on not to interfere with Spot's young. Below: Nazu, on the right, engages in a fight with a juvenile male. Nazu is carrying the male infant of a low-ranking female.

dependence. An infant's survival depends on its mother's survival and her willingness and ability to look after it properly. Mothering is as vital a skill as foraging or defense against predators.

In southern Kenya, the harsh environment provides an acid test for motherhood. Over a quarter of the baboon infants in the study group die in their first year, and almost another quarter in their second year. (The death rate after that, when the juvenile baboons have grown stronger and are less dependent on their mothers, is very low.) While maternal care is by no means the only factor in reducing infant mortality, it is undoubtedly a significant one: in Amboseli the effects of poor mothering are sometimes painfully and incontrovertibly clear.

One of the things that has become increasingly evident in the primate research of the last few decades is that monkey mothers, like humans, do not all treat their infants in the same way. Some are indulgent, some are snappish; some quickly give in to their infants' tantrums while others do not. Some keep their infants constantly under their eye, while others let them roam unsupervised. The question naturally arises: Which of these ways of mothering is "best"? And how do the baboons—uninfluenced by either Dr. Spock or the Book of Proverbs—arrive at their various ways of treating their offspring? What makes one baboon mother "permissive" and another "strict"?

The Amboseli project's long-term records provide a wealth of data on the baboons' genealogies, environment, and past experience to help answer these questions. When the observers watch an infant growing up they know which baboons are its mother's habitual allies, which are her foes, and which are her "sisters and her cousins and her aunts"—the network of female relatives that provides much of the stability and solidarity of baboon society. They know her day-to-day relationships with males in the group, her medical history, her temperament, and her position in the dominance hierarchy. They know how many infants she has had before, how she has treated them, and how—or if—the infants have grown up. They also have comparable data on all the other infants in the group that are growing up at the same time, in the same social and physical environment.

Much of this information is impossible to obtain in the wild unless research personnel and funding are sufficient for continuous observation over many years. Generations of baboons mature and succeed each other only slowly, and Amboseli is one of the few field sites in the world where it has been possible to gather such a wide range of detailed information on several generations of free-ranging primates. On computer tapes and in notebooks and cardboard boxes, in the base camp's thatched-roof house and in laboratories at Cornell and the University of Chicago, is a rare treasure of clues to an old and unexhausted mystery: Why behavior differs from individual to individual, from family to family, and from generation to generation—and what the consequences of these differences are.

Unlike the monkeys in a number of other field research projects, the Amboseli baboons are not fed by the researchers. They are thus less "friendly" with the observers and more vulnerable to shortages in the natural food supply. In this natural situation, researchers can see how the baboons cope with the harsh and prime necessity of making their own living—which, for them as much as for any other animal, dictates much of the rest of the pattern of their lives.

Far from indulging in monkeyshines, the Amboseli baboons work a Victorian factory-hand's hours. In the dry season they spend as much as 80 percent of their day searching for food and processing it: digging roots, picking berries, shelling seeds, darting after grasshoppers. Although the baboons forage together as a loose group, feeding is an individual matter—there is almost no food sharing among adult baboons—and thus a mother with a small infant has to work just as hard as a male or an adult female without an infant. If anything, she has to work harder, because as long as she is nursing the infant (that is, for much of its first year), she has to "eat for two."

Mothering thus seems to be a particularly demanding occupation, and the hard facts of Amboseli bear out this supposition. The death rate for females with dependent infants is almost twice as high as for females without infants. A mother dragging behind the group, distracted by her infant or too tired to be wary, is likely prey for a leopard or a hyena. When a fever or a viral epidemic strikes the baboon population, it is the mothers of young in-

Below: A youngster takes food from an unrelated female. Baboons feed on the rich inner parts of grass corms, but infants do not have the strength to dig up large corms. Right: Nibbling at a succulent, this infant is supplementing its diet of mother's milk. By the age of four months, infants begin to try a variety of foods, but most will not be completely weaned until they are about a year and a half old.

fants, perhaps overtired and undernourished, who are most likely to fall victim.

Scar, then, had reason to "look awful" on the day the observer saw her with her new infant. This was her fifth infant in eight years—and older mothers are even more vulnerable than young ones to the stresses of their task. If Scar had the disadvantages of age, however, she also had the advantages of experience. When her new infant cried she hitched it up so that it could reach her nipple more easily; and when it was too tired to cling by itself she supported it with one hand.

New mothers often hold their infants awkwardly for the first few days and seem puzzled by the infants' cries of discomfort. Most learn quickly enough how to help the infant cling and nurse, but a few mothers have serious difficulties with these skills. When Vee gave birth to her first infant, Vicki, in 1976, she held it upside down and backward for most of the first day, sometimes dragging and bumping it along the ground. Vicki was not able to get on the nipple until the next day. Although Vee usually held the infant right side up thereafter, she was never a very attentive or competent mother; Vicki died three weeks later, probably as a result of early mistreatment. Nazu, who had her first infant in 1979, was also clumsy and inattentive with the infant. Sometimes she sat on it. When it was six days old it was kidnapped by Scar's grown daughter Summer, but Nazu did not seem greatly disturbed. She made little effort to get it back, and three days later the infant died.

The possibility of such kidnapping is another factor, along with simple environmental pressures, that adds stress to a mother's life. Other baboons, particularly other adult females, seem fascinated by young infants: a mother is approached six to eight times as often in the weeks after her infant's birth as she was in the weeks before. This may at first seem benevolent interest, like that of humans who pause by a baby's stroller and smile. But baboon mothers are often nervous of their neighbors, and they often have reason to be. Another adult female's "interest" in the infant may extend to snatching it and carrying it away with her. Since she cannot nurse it and may mistreat it, the result, as in the case of Nazu's first infant, may be death.

It is not only the offspring of indifferent mothers that are subject to kidnapping. Handle was one of the two most protective mothers in the entire group, but she lost her two-day-old infant, Hans, to another adult female and, despite her persistence, was not able to get him back until the next day. By then he was dehydrated and weak, unable even to cling to his mother. Unlike Nazu's infant, however, Hans recovered from the kidnapping. Hans's kidnapping points up an important fact about maternal care: namely, that the mother and her behavior are not the only factors in the infant's life. A very protective mother may be overpowered by stronger individuals; an indifferent mother's infant may get care from the rest of the group.

After its mother, one of the most important figures in the infant's life is an adult male that is a frequent companion of the mother and that is often, but not always, the infant's father. This special male companion lets the infant ride on him, sit in his shade on hot afternoons, and eat scraps of his food when it is old enough. Equally important, he protects the infant from too-curious neighbors. Other baboons are less ready to approach a mother and a new infant if their male protector is with them, and he may overtly threaten animals that try to pull at the infant.

Developing a helpful relationship with an adult male, like caring for the infant itself, is not something first-time mothers do immediately or without difficulty when their infant is born. Handle, like many new mothers, took more than a month before she accepted and made use of adult male Even's attempts to stay near her. It was during this initial period, when Handle was still going it alone, that Hans was kidnapped—and one of the reasons she could not get him back more quickly was that the kidnapper, Gin, enlisted the aid of her companion, Red, a young adult male just beginning his rapid rise through the dominance hierarchy of the group. He helped keep Handle from getting close enough to Gin to retrieve Hans.

Gin gave birth to her own first infant about three months later. She was far less protective of Grendel than Handie was of Hans; but, in a sense, she had less need to be. Although she was as inexperienced as Handle and about a year younger, she was somewhat higher ranking and also made immediate use of her relationships with males. Red stayed close to Gin and Grendel from the first and kept the other baboons from pulling at Grendel. (There was

no evidence that he was Grendel's father.) He had also approached Handle and Hans in recent weeks, with the apparent intention of playing the protector's role there, but Handle, perhaps remembering his part in the kidnapping, avoided him. By then Hans and Handle had acquired a male companion of their own that helped keep Red away.

When Grendel was a month old, Red left the group. It is common for young males to move in and out of groups, and Red was a particularly frequent migrant during this year. His weeks with the group were full of fights with other males, as he worked his way up the dominance hierarchy. His first absence after Grendel's birth was one of his longest—nearly two months—and he and Grendel never resumed their early relationship after his return. Grendel had meanwhile picked up a new protector: his probable father, High Tail. The two of them were particularly close, in large part because Gin tended to reject and avoid her infant. Grendel sat next to High Tail, rode on him when the group moved, and ran to him in moments of alarm or distress. In May, at the end of the long spring rains, an epidemic struck the group. High Tail fell very ill: for some days he did not eat. He moved as little as he could and swayed when he moved. Two baboons died in this epidemic—typically enough, a mother and her young infant—but by the middle of the month High Tail was recovering.

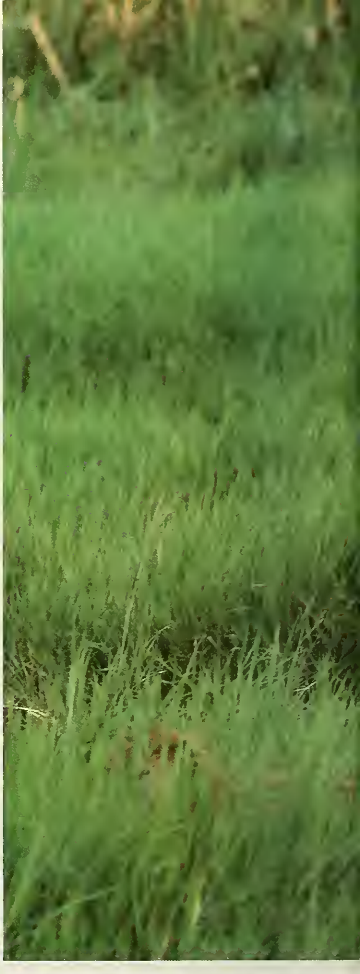
One morning the observers arrived to find the whole group agitated, apparently by the presence of a leopard in the high grass around the grove. The baboons came down from the trees later than usual and moved away quickly in a tense compact group, quite unlike their usual, scattered, dawdling morning start. As they left the grove, several juvenile baboons looked up into a nearby tree. The observers, following the baboons' line of sight, saw High Tail's half-eaten body hanging on a branch—apparently, he was a victim of the leopard that waited and watched in the long grass.

Grendel, now four months old, was again without an adult protector. He tried to spend more time with his mother, but Gin was as unwelcoming as before—shrugging him off when he tried to climb on her for a ride and snapping at him if he grew insistent. He tried to attach himself to a number of baboons in the group, but none was as tolerant of him as High Tail had been.

Baboons seem to make a distinction between very young infants with black coats and older infants with adult coloring. It is the black infants that they gather around and want to touch, and it is the black infants that they are usually ready to carry. Grendel's coat was turning golden brown when High Tail died, and although he got brief rides from many members of the group, he had to survive largely on his own. He still nursed from Gin, but only in her more tolerant moments.

Hans, on the other hand—two months older than Grendel—could suckle and ride on his mother almost at will. Handle, anxious and protective, still let him stay close to her. Even Handle, though, eventually hit Hans and shook him off when he tried to ride, and even Gin had let Grendel suckle at will when he was very small. The difference between "harsh" and "gentle" mothers is perhaps not so much an absolute difference of temperament as a difference of timing. Grendel's mother first rejected him when he was one month old;

Below: In the branches of a fever tree, Nazu grooms an unrelated infant. Ironically, Nazu proved a poor mother toward her own first infant, which was kidnapped by another adult female when it was six days old. Nazu made little effort to retrieve her infant, and it died three days after the incident. With experience, she has become a better mother. Right: Standing on the back of his mother, Scar, Spike peers over the lush grass at the edge of a water hole. Tolerant mothers often allow their young to hitch a ride.



Hans's mother not until he was five months old.

The difference between care and rejection is a matter of timing in another sense, too. As the infant grows larger, the mother needs to feed more to produce enough milk. At the same time, the infant is capable of greater independence and can play by itself without risk of kidnapping or of getting lost. Thus when it is very small, the infant rides on the mother, suckles from her while she is feeding, and moves away to play only when she has stopped to rest and can keep an eye on it. By the time the infant is four or five months old, it is seriously in its mother's way if it rides or suckles while she feeds, and she cannot afford to let it interfere. If she is malnourished, the infant will be too. At this age, the best arrangement for both mother and infant is for the infant to run about on its own while the mother is busy foraging, and for the infant to cling to her or suckle only when the mother sits down to rest—an exact reversal of the daily pattern in earlier months.

The accomplishment of this reversal seems to cause the most trouble between baboon mothers and infants. The fourth month of the infant's life, when the transition usually takes place, is rather like the "terrible twos" for human children. Infants throw violent tantrums, and a mother's patience wears thin. (In the first few months of their infants' lives, Spot and Gin were the only mothers that acted aggressively or punitively toward their infants. By the end of the fifth month, however, every mother in the study group had bitten, pushed, grabbed, or hit her infant.)

The question is why some mothers push their infants toward independence at an early age while other mothers hold them back until later—and which method is best. The key to the question, as it turns out, is maternal rank. Whereas male baboons change rank fairly often, rising and falling in the dominance hierarchy, most females keep the same rank throughout their adult life. They also stay in the same group, whereas the males migrate. Thus the stable core of a baboon society is its adult females, which range together over the same area for twelve or fifteen years and maintain the same relationships with each other, while males come and go and infants are born and die or grow to adulthood around them. As juvenile females grow up, they usually take a place in the hierarchy just below their mother's, so that the stability of female baboon ranks continues across generations.

In baboon, as in human, society, life is rather different for individuals at the upper and lower ends of the hierarchy—and this is as true of motherhood as of any other aspect of life. All but one of the higher-ranking mothers in the study group were early rejecters of their infants, while all but one of the lower-ranking mothers were protective. Alto and her daughter Spot, for example, at the top of the hierarchy, pushed their infants toward independence at an extremely early age, while Brush and Handle, near the bottom of the hierarchy, kept their infants "tied to their apron strings" for months.

And which strategy proved best? In the Amboseli study it was evident that one strategy was best for some baboons, while the other was best for other baboons. Even within one small social group, the circumstances in which mothers found themselves varied greatly; and the way they treated their infants varied to fit the circumstances. For infants of higher-ranking

mothers, the social world is relatively benevolent. Other baboons are potential helpers—or can be made to be helpers. Alto's daughter Alice spent much of her time with other mothers in the group, sitting in their laps and even pushing their infants aside in order to make room for herself—thus earning the sobriquet Alice the Obnoxious from one observer. If the other mothers pushed Alice away too roughly, they were likely to get trouble from their "superiors," Alice's mother and sisters.

Alice's relative independence from her mother proved to be beneficial not only to Alto but to Alice herself. When Alto died, Alice was only sixteen months old—the youngest orphan in the Amboseli study ever to survive alone. It is possible that if she had been less accustomed to feeding and traveling on her own, and less practiced in enlisting the aid of others in the group, she would not have survived her mother. For the lower-ranking mothers, on the other hand, the social environment is hostile. Other baboons are potential kidnappers, food stealers, and attackers of infants. A mother at the bottom of the hierarchy needs to be protective. For her infant, the risks of early independence are likely to outweigh the advantages.

Since young female baboons like Alice "inherit" their mother's rank, while young males like Grendel and Hans have to fight their way to whatever rank they can reach by their own exertions, it is peculiarly suitable that high-ranking mothers in the Amboseli study have tended to bear more female infants, which are sure to be high ranking themselves, while low-ranking mothers have tended to bear more male infants, which at least have a chance to work their way to a higher rank. By some process that is not yet understood, mothers seem likely to give birth to the sex of infant that will have the best chance in life.

The sex-ratio difference is a subject for continuing research at Amboseli, as is the behavior of aging mothers such as Alto. The observers did not know Alto in her youth and had no opportunity to compare her earlier and later maternal behavior. But by now some of the females that were hardly more than infants themselves when the Amboseli project began have had several infants of their own. It remains to be seen whether, as expected, they will be less restrictive with their new infants than they were with their earlier offspring. As a mother grows older, the likelihood increases that she will die before her infant, as Alto did. It would be to the advantage

A young female explores the branches of an umbrella tree. Infants can climb these trees at an early age, but they sleep in acacia, or fever, trees because of their smoother bark and higher branches. Leopards are sometimes successful in preying on the sleeping baboons.

of the infant to learn to survive on its own at an earlier age; and for that reason (if not from sheer exhaustion) the mother may watch over it less closely than she watched over its older siblings.

The infants that were born in the first year of the mother–infant study have just become mothers, and it remains to be seen whether, as expected, they will bring up their infants in the same way they were brought up. The mother–infant study turns to new sets of questions; meanwhile, systematic observation of Alto's Group goes on from season to season.

In November the first rains come and the savanna turns green. Soon the fever trees and their relatives the umbrella trees come into flower, and the groves are hung with puffball clusters of white and yellow blossoms. The infants born in early summer are beginning to find their own food and eat the sweet flowers like candy. The umbrella trees especially, with their rough bark and low branches, tempt the infants to climb. When the group comes to one of the umbrella-tree groves, whose flat, feathery lines mark the savanna horizon, the infants go scrambling up, eat their fill of sweets, and swing Tarzanlike down the vines that hang from branch to branch. The open land is carpeted with the pink-lavender, primroselike flowers of *Rhamphicarpa montana*, which the infants pull by the handful to eat. Sometimes a small baboon, its mouth still full of flowers, comes bobbing across the grassland, eager to join the group. At this time of year life is easier for the baboons, and they need less of the day to find and process food. Most of the next year's infants are conceived at this time, the relaxed and full-fed days of the warm-season rains.

It is the best of times and the worst of times—for baboons and scientists, respectively. "This is not my conception of doing research," one new observer, undergoing his baptism of mud, wrote home. "Dec 17 it rained and we could not find any baboons; Dec 18 it rained but we found Alto's Group, however we used up half a tank of gas driving in 4-wheel and had to leave at noon to avoid being stranded; Dec 19 it rained . . . spent most of the day digging ourselves out of the Emali road; Dec 20 it rained and we could not find any baboons; . . . [addenda Dec 20: 1 flat tire during the day, that night organized search party to find (other researchers) who were 3 feet deep in mud]; Dec 26 finally found Alto's Group, the steering control on the Land-Rover broke, we abandoned the vehicle in the field. . . ."

With a little practice, however, the baboons are easier to find, and the harder soils on the savanna easier to tell from the bottomless mud. In January and February comes the respite of the interrains. In March the long stormy season sets in: Kilimanjaro's mantle of snow hangs lower, and cloudbursts sweep the savanna. By the time the worst mudholes have dried out again, the first of the infants conceived in the "short rains" will be born.

"Bring on the cigars!" runs the message from Kenya to Chicago. "Vee had her baby! Another girl, as one would predict." Vee is high ranking, and so far has produced nothing but female infants. "Voodoo has crossed eyes but otherwise is looking pretty good." Vee is more experienced now than she was five years ago, when she bumped the unfortunate Vicki like a potato sack across the savanna: "Vee has handled her very well; even Alice the Obnoxious has to watch her p's and q's." The information about Voodoo's birth is filed in a notebook and entered in computers at Cornell and Chicago, where it can be matched up with dozens of other sets of data on births and deaths and matings, aggression, feeding, neighbor relationships, and group movements. One of the Chicago workers—following the Amboseli news like the latest installment of a soap opera—calls down the hallway, "Hey, Vee had her kid!"

If Voodoo is left more on her own than her older sisters were or if she is treated differently from infants born at different times of the year or if her mother expends more energy on her than a restrictive mother like Handle, the researchers in Chicago will know, in this new phase of the mother–infant study—and we will all know more about the effects of mothers and infants on each other's lives and about their relations with the society around them. ☐

After breeding in the woodlands of eastern North America, the great crested flycatcher migrates to Panama and Colombia. There, it joins mixed-species flocks in the forest canopy and supplements its insect diet with fruit.

John Gerlach

Northern Birds at Home in the Tropics

When the snow flies in the Northern Hemisphere, many of our birds fly south. Where do they go and are they really "ours"?

by John W. Fitzpatrick

Every year between July and October, a natural spectacle of global proportions passes over the Northern Hemisphere as regularly as clockwork. Only a few weeks after the days start to shorten, a myriad of birds from Alaska to Nova Scotia begin individual journeys southward from their North American breeding grounds. The spectacle opens slowly, with initially sporadic movements by sandpipers, plovers, and terns, whose arctic habitats feel the signs of approaching autumn as early as July. Momentum builds in August, as warblers and flycatchers abandon the northern forests, and swallows, blackbirds, and finches across the continent begin to flock and move south. Fall migration reaches fever pitch in September, when gardens, wood lots, golf courses, and lakeshores teem with songbirds and the skies are flecked with lazily swirling kettles of migrating hawks. By October the spectacle is subsiding as the last few sparrows and thrushes linger through Indian summer.

Quite a number of these species move only short distances to warmer parts of North America. While snow flies in the more temperate latitudes, they supply Christmas Bird Counts in the Sunbelt states with massive tallies of overwintering species. A large proportion of the familiar summer birds of North American forests and plains, however, disappear from the continent altogether during the autumn spectacle. Bird books tell us that they are "wintering in the tropics" and that we will see them again in bright spring plumage when the spectacle roughly inverts itself the following April and May.

What becomes of "our" birds between September and April, those that leave us altogether? Do they find the tropics a luxuriant paradise with unlimited vacant space and abundant food or must they sneak into habitats already teeming with resident birds and compete for a living at the ecological margins of a crowded environment? Do their wintertime distributions fall into geographical patterns? Do they winter as nomads or do they live in discrete home ranges, perhaps even defended territories? How do resident bird communities respond to this great annual coming and going of visitors from the north? How will the ever worsening destruction of native tropical habitats affect Northern Hemisphere breeders that spend the winter in the disappearing forests and scrubs of Latin America?

Researchers from various disciplines are now examining these questions, and in 1977 sixty of them assembled in Front Royal, Virginia, for a symposium on this topic sponsored by the Smithsonian Institution. Getting a group of ornithologists, ecologists, behaviorists, and zoogeographers to agree about anything is usually impossible, but in this case a remarkable unanimity developed on an important point: the migrant birds so often referred to as North American species are just as much tropical birds as they are north temperate ones—and perhaps even more so. This realization has become a focus for scientific thinking about the great annual migration of birds to and from the tropical latitudes of the New World, a region known to geographers as the Neotropics. My work in this area has centered on the tyrant flycatchers, a large and diverse group of birds that illustrates some of the geographical and ecological patterns characteristic of northern migrants in the Neotropics.

The tyrant flycatchers make up by far the largest family of birds in the New World. Of the approximately 375 species, all but about 30 regularly breed south of Mexico. The ecologically diverse tropical flycatchers vary in size from truly tiny (smaller than most hummingbirds) to the size of robins or jays. North America's breeding flycatchers are far more uniform in size and habits. Except for the kingbirds, which are large, strikingly colored inhabitants of meadows and prairies, most North American flycatchers are small, dull green birds of orchards and forests. In contrast to their diverse tropical relatives, the northern species all make their living in roughly the same way: they perch on exposed or semiexposed lookouts from which they dart to snatch unwary insects. They usually return to the same few perches throughout the day. Although this foraging style represents only one of many found in the family as a whole, it is an extremely successful one among birds the world over. Ecologically speaking, the

Many northern migrant flycatchers do not maintain winter territories in South America. One migrant that does is the eastern wood pewee, below, which defends territories along forest and river edges much as it does in the north. The pewee is an ecological replacement for the South American vermilion flycatcher, facing page, which occupies these habitats during the austral winter and migrates to Argentina just as the pewee arrives.

Gregory K. Scott

flycatchers have more or less exclusive control of this foraging niche within North America.

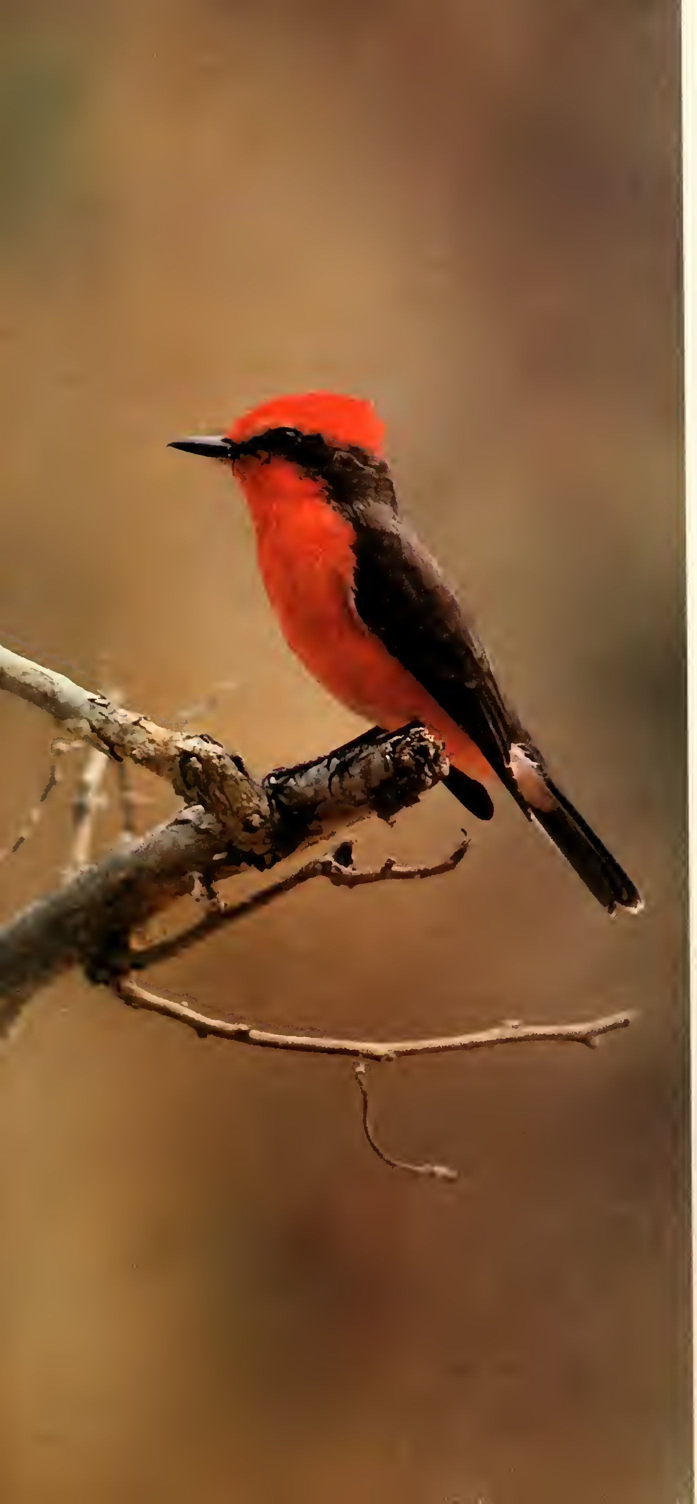
All thirty species of flycatchers that breed north of Mexico migrate to some degree. A few southerly species, such as the vermilion flycatcher and the thick-billed kingbird, simply move into northern Mexico. The more northerly eastern phoebe winters in the southern United States and adjacent Mexico; it is the only common flycatcher east of the Rocky Mountains during the winter. Most of the other species make long-distance movements between summer and winter homes.

A plot of the wintering distributions of these flycatchers shows a distinct buildup toward southern Mexico, with a peak of about fifteen co-occurring winterers around the Isthmus of Tehuantepec (17°55′ north latitude) and adjacent Guatemala. South of that region the numbers drop off again. Eight reach Panama, six extend well into Colombia, and only four flycatchers regularly migrate as far south as Amazonian Peru. The same general pattern is reflected in the wood warblers, the other large family of northern-breeding songbirds to file into the Neotropics for half the year. (Unlike the flycatchers, however, additional warbler species flood the larger West Indian islands as well as the continental tropics.) In general, when all the northern land birds that migrate to Central and South America are lumped together, both diversity and abundance are highest in upper Central America. Species diversity of northern migrants gets progressively lower toward the equator. With only a few exceptions, a bird watcher interested in seeing so-called northern birds on their tropical wintering grounds is best off searching the forests and scrubs between southern Mexico and Costa Rica. The most dramatic exception to this pattern lies in the arctic-breeding shorebirds, many of which winter on the marshes, grasslands, and coastlines of southern South America.

During their breeding season, most North American flycatchers can be classified as either eastern or western, although a few eastern species extend sparsely across boreal Canada to Alaska. South of the coniferous zone, the Great Plains separates the breeding grounds of the two groups. Plotting the wintering distributions of eastern and western flycatchers produces informative patterns. Virtually all the western species move down the Mexican mountains toward Central America, more or less stopping at southern Mexico and Guatemala. In contrast, the eastern flycatchers make a major jump across the Gulf of Mexico. A few eastern species winter in central Mexico but the peak occurs farther south, in Panama and adjacent Colombia. The two largely separate groups of winterers meet in southern Mexico, which accounts for the increased diversity in that spot compared with north or south of it.

Exactly why the eastern species move farther south than western ones remains unclear, but this pattern is repeated in most other migrant songbird groups. Several factors are probably involved. A songbird breeding in western North America can migrate southward without encountering any change in habitat other than a gradual increase in temperature and aridity, and many of the western species breed in mixed pine/oak habitats very similar to those of the Mexican plateau where they spend the winter. Eastern North American breeders, on the other hand, are more likely to inhabit humid, broadleaf forests and woodlands. Moreover, during their autumn journey southward, the eastern birds must deal with a vast habitat totally unsuitable for them—the Gulf of Mexico. Many eastern migrants fly across the gulf, while others stream down the eastern coastline of Mexico. A few of the species that follow the coastline do winter in the moist forests of eastern Veracruz, Mexico, but most of them, and virtually all of the transgulf migrants, must reach the middle of Central America to encounter appropriate forested habitat. Only when they reach Costa Rica, Panama, and South America do they find truly extensive stands of humid, broadleaf forest.

This kind of geographical replacement can be seen even more dramatically when groups of ecologically similar species are compared separately. The highly migratory kingbirds, for example, all share a predilection for open habitats, where they make long, graceful sallies in pursuit of aerial insects. In the winter, they supplement this insect diet with fruit. On their breeding grounds, kingbird species are largely separate from one another geographically. (In most cases where overlap occurs, the species have been shown to segregate the habitat ecologically.) On their wintering grounds, a similar distribution develops as the species settle into their tropical homes. Of the three primarily western-breeding species, Cassin's kingbird uses northern and central Mexico, the western kingbird winters in southern Mexico and northern Central America, and the scissor-tailed flycatcher (now recognized as a kingbird) concentrates in the middle of Central America. Of the two eastern species, the gray kingbird winters in Panama and Caribbean South America, and the eastern



kingbird in Amazonia south to Argentina.

Similarly, when the small *Empidonax* flycatchers are separated into groups of species that share similar overall habitat preferences, well-defined geographical replacement is seen to characterize their wintering distributions. The result of this kind of pattern is that closely related migrant flycatchers rarely have to compete on a local scale. Thus, some of the species complexes that pose problems for bird watchers in spring are shaken out into geographically separate areas in winter.

What about the migrants' relationships with resident species? The Neotropics support some of the richest and most diverse bird communities in the world, including a total of well over 300 resident tyrant flycatchers. It would be impossible for the migrant flycatchers to winter in regions that are entirely free of ecologically similar species. For many years, North American migrants were assumed to winter around the ecological periphery of most major tropical habitats, using superabundant resources or those that were of marginal interest to the residents. In this traditional view, the northern birds fill in the ecological cracks during their months as visitors in the tropics.

One way to examine the merits of this view is to look at the distribution of habitats used by both wintering migrants and their resident relatives, to see if some ecological separation exists within a local region. A group of birds to study in this regard is the community of fifteen small, sallying flycatchers consisting of the genus *Empidonax* and its relatives. During the northern winter, all but one of these species occur somewhere between central Mexico and Panama. Eight are migrants, and of these, the eastern species tend to settle along the forested Caribbean slopes while the western species use the drier hillsides of the interior and the west. Only the alder flycatcher, an eastern species, moves entirely into South America.

If the prevailing lore were correct, the eight migrant *Empidonax* species should winter in rare and peripheral habitats because the seven year-round resident species should dominate the widespread habitats of Mexico and Central America. Sur-

G. Ziesler; Peter Arnold

Scissor-tailed flycatchers, which are now recognized as kingbirds, migrate from the southern Plains states to Central America. A small population of these birds also winters in southern Florida.

Bob and Clara Calhoun; Bruce Coleman

prisingly, the reverse appears to be true: the migrant species actually form the dominant small flycatcher element in the most widespread vegetation types in their tropical wintering grounds. In the lowland forests of the Caribbean coast, two migrants, the acadian and yellow-bellied flycatchers, predominate. Where forest breaks into woodland or brushland, least and willow flycatchers, also migrants, make their winter homes. None of these coexists with a single closely related resident. On the higher, drier ground of the Mexican plateau and the Pacific slope, a wintertime *Empidonax* flycatcher found in a wooded ravine could be any of four species (least, willow, western, or gray flycatchers), all of them North American breeders. The oak and mixed pine/oak woodlands of medium and high elevations are the winter homes of two more migrants, the dusky and Hammond's flycatchers. Only in the high-altitude zones, mostly near the tops of mountains above 3,000 feet, do resident relatives of these flycatchers occur. They, not the migrants, are confined to rare, local, ecologically peripheral habitats.

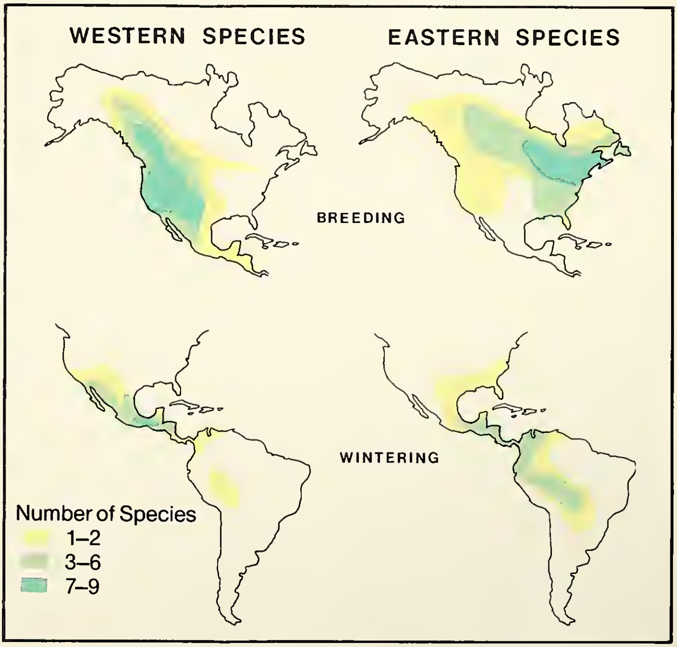
Studies of warblers wintering in Central America and the West Indies have produced similar results. Working in Veracruz, ornithologists J. Rappole and M. Ramos, then of the University of Minnesota, found that many of the migrants they studied, which included flycatchers as well as warblers, form a stable community in the tropical forest understory. They confirmed that many, perhaps most, of the migrants defend territories against members of their own species just as rigidly as they do on the breeding grounds, and that in many cases, the migrants are more common than their resident counterparts.

Among the small, foliage-gleaning warblers that occur on Caribbean islands, the situation appears even more biased in favor of the migrants. John Terborgh of Princeton University found that on the larger West Indian islands, tightly packed communities of migrants from eastern North America clearly dominate the most widespread habitats even though they leave for a few months each year to breed elsewhere. In sharp contrast, resident Caribbean warblers, virtually without exception, are confined to isolated small islands, mountaintops, mangrove flats, and other ecologically peripheral habitats.

The ecological position of many migrant flycatchers and warblers seems to be radically different in South America. Whereas northern migrants dominate a variety of Central American habitats during the winter months, migrants do indeed become more peripheral in the heart of South America, especially in Amazonia. The four species of migrant flycatchers in Amazonian Peru, for example, are confined to openings and short-lived, early successional forest edges and river margins. Two of these species, the sulfur-bellied flycatcher and the eastern kingbird, undergo a dramatic shift in behavior and feeding habits between their breeding grounds and their Amazonian wintering areas. Both are almost exclusively insectivorous in the north, where solitary pairs breed on vigorously defended territories. In September their solitary habits disappear, and both species move southward in large flocks.

During the migration and especially on the wintering grounds, these two large flycatchers subsist almost exclusively on fruit gleaned from huge trees that are common along Amazonian rivers and oxbow lakeshores. These tall fruiting giants produce prodigious quantities of ripe fruit over just a few days' time, so that no resident species (bird or mammal) could ever competitively exclude other species from feasting on the resource, although a few of them do try. In South America, the eastern kingbird becomes highly gregarious and subordinate to its resident flycatcher relatives. Kingbirds can be seen traveling in huge, nomadic flocks reminiscent of blackbirds. The flocks descend on big fruiting trees, where the individual kingbirds are harassed by the resident kingbirds, kiskadees, and other large flycatchers. Instead of fighting, however, the kingbirds, famous in their summer homes for their pugnacity, seem to enjoy safety through overwhelming numbers. They escape the harassment by retreating into the midst of the flock, effectively swamping out the efforts of the residents. The sulfur-bellied flycatchers are found in smaller flocks and are much less conspicuous, but they too are subordinate to the resident species.

One North American flycatcher—the eastern wood pewee—does manage to maintain winter territories in South America, defending them with displays and other behaviors similar to those it uses



Of twenty-two species of migratory flycatchers that regularly breed north of Mexico, ten breed primarily in eastern parts of North America and twelve in the west. The western species generally migrate no farther than Costa Rica, while many eastern species winter in South America. Southern Mexico, where the two groups meet, supports the greatest diversity of migrants.

AMNH

thousands of miles to the north. Interestingly, for the half year it spends on its wintering grounds, the pewee is an unusually close ecological replacement for a South American relative that migrates southward out of Amazonia to breed in Argentina just as the pewee arrives from the north. This relative is the vermilion flycatcher, a species that breeds from southern North America all the way south to Argentina but does not breed in Amazonia despite its abundance there for half the year.

Both the pewee and the vermilion flycatcher customarily sit on exposed perches along forest edges and the margins of rivers and lakes, repeatedly sallying forth into the air to snatch flying insects. If both species were present simultaneously, they would perch in many of the same areas, forage on the same populations of insects, and potentially compete with one another. Instead, river edges throughout most of Amazonia are occupied by one species during the north temperate winter and the other species during the austral winter. An intriguing possibility is that the arrival of a wintering competitor with a markedly similar ecology may actually prevent the other from successfully breeding in the Amazonian basin. Whatever the reason, both species occur in Amazonia as migrants, and like so many migrants in South America, both dwell in brushy edges and temporary forest openings, not in the primary forest itself. They use habitats that are local and patchy in both space and time, with very short life expectancies in comparison with dominant, more permanent habitats such as forest, scrub, and even desert. In most of the more widespread South American habitats, resident flycatchers vastly outnumber all other songbird groups. Perhaps, within the unparalleled richness of the South American bird communities, the old adage about migrants being ecologically peripheral is closer to the truth than it is in Central America.

Why is it that among the flycatchers and warblers the ecological position of migrants in the Neotropical communities changes so dramatically between Central and South America? On one level, the difference is one of numbers, simply reflecting that most Neotropical migrants stop before they ever reach South America. But why do so many of the wintering populations of hundreds of species that breed in North America stop in Central America? To me, the most plausible explanation lies in the difference in the numbers of resident species in Central and South America. Any North American breeding songbird that makes the trek to the central Andes or to Amazonia encounters the richest resident bird fauna on the planet. In these areas, where climate varies only slightly the year round, tightly structured communities have evolved among the resident species in virtually all habitats, leaving relatively little ecological room for species that are away for half the year.

In the Central American tropics, where the climate is far more seasonal, migrants coexist with considerably fewer resident species. Furthermore, because there are fewer miles between the wintering and breeding grounds, the migrants can arrive

As habitat destruction in the Neotropics eliminates their winter homes, the populations of many migrant species will decline. The Kentucky warbler, for example, seems to be showing up in reduced numbers at its breeding grounds.

F. J. Alsop III; Bruce Coleman

sooner and leave later than can migrants to South America. Consequently, they may spend up to eight months of the year fully integrated into the most widespread tropical communities of Central America. Finally, the average population density of migrants in Central America is higher than these same species would produce if they wintered in the greater land area of continental South America. As a result of these various numerical patterns alone, the western North American flycatchers and other songbirds have become a dominant element in what amounts to a Central American extension of their mountainous breeding habitat. Some eastern North American birds occupy similarly important positions in the moist forests of southern Central America, but the group as a whole gradually loses its dominance to the increasing numbers of residents in Panama and Colombia.

An intriguing possibility, still largely untested, is that the huge community of Central American winterers actually has helped to limit the northward dispersal of many tropical South American forms. Most resident bird groups now occupying tropical Central America originated in South America, spreading northward as the two continents approached each other and finally joined about three million years ago. Although some dispersal in both directions through the Isthmus of Panama clearly took place, there is evidence that not all tropical bird groups have had an easy time reaching Central America from the south. For example, the resident Central American flycatcher community is especially depauperate in small, sallying species when compared with the fauna of northern South America. This is precisely the type of flycatcher most commonly represented in the migratory western North American fauna. I hypothesize that this and many other so-called ecological vacuums in Central America are not really vacuums at all because for well over half the year they are occupied by migrants from North America. In this fashion, a mobile fauna constitutes an integral portion of the Central American bird communities, even though its species leave for a few months each year to breed in the rich, but short-lived, springtime of the temperate latitudes.

Similar views about the central role played by Neotropical migrants in their winter communities were voiced repeatedly at the 1977 Front Royal symposium, with evidence cited from a wide variety of regions and bird groups. Even more important than its theoretical significance, the observation that these migrants are just as much tropical species as they are northern ones has some serious, potentially drastic implications, involving conservation and ecosystem preservation. We are discovering that preserving the breeding habitats of these migrants is only half the story. Several species that winter deep in the tropical forests of Central America seem to be showing up in reduced numbers on their breeding grounds, perhaps signaling the loss of their winter home. Two of the most alarming examples are the hooded and Kentucky warblers, birds that breed in the forest understory and winter in the disappearing humid forests of Central America. Admittedly, the destruction of native habitats in the Neotropics will not be uniformly deleterious; species accustomed to wintering in peripheral habitats are bound to flourish in disturbed areas. The chestnut-sided warbler has been cited as one possible example, and the indigo bunting may be another. Many others, however, will inexorably decline as their wintering habitats are eliminated. The destruction will have its greatest impact on migrants to Central America, both because deforestation has been especially severe there and because more species winter there than in the still more intact habitats of South America.

The effects of these changing abundance patterns on the familiar springtime chorus of returning migrants are still largely unknown, but change is inevitable. While we in North America have long considered the birds that fly south every autumn and return every spring to be "ours," the birds make no such distinction. They are full-fledged members of countless tropical communities, and as those communities change, so will our North American ones. The birds treat this as one world. □

Photographs by Richard D. Gordon

Several Golok tribesmen watch over the string of yaks that carry food and equipment for the expedition as it moves across the barren, treeless terrain of the Tibetan plateau.

Journey to the Tibetan Plateau

The once-feared Goloks are as much an endangered species as the rare Tibetan animals they hunt

by Orville Schell

On June 5, 1894, while returning to China after an unsuccessful attempt to reach Lhasa, the French explorer Dutreuil de Rhins happened upon a small settlement called Tongbudmo on the northern tier of the Tibetan plateau. Stopping to find shelter from a storm, de Rhins got into an altercation with some of the local Tibetan nomads over two horses that he claimed had been stolen. In short order, the angry nomads began firing on de Rhins's small band, wounding him and driving his confreres away. The nomads then sewed the injured explorer into a yakskin bag and threw him to his death in the freezing waters of the Do Chu River.

"One must take for granted that every Tibetan, at least in this part of the world, was a robber sometime in his life," wrote the great Viennese-born explorer Joseph Rock sardonically, after a later attempt to enter the area and find the "spirit mountain" Anyemaquen had been rebuffed. "Even the lamas are not averse to cutting one's throat, although they would be horrified at killing a dog, or perhaps even a vermin." Although they had a reputation for being devout Buddhists, the nomads' compassion for all living creatures apparently did not encompass human beings.

Living along one of the three main caravan routes into Lhasa—the border area between Tibet proper and China's Qinghai Province—these nomadic herders of yak and sheep were legendary for their hostility toward intruders. But of all the tribes in the area, it was the Goloks whose ferocity was most renowned. "They attack anyone approaching the regions west of the Yellow River," wrote Rock after a lifetime of exploration in the region. "They acknowledge no one's authority except their chiefs'. . . . They enjoy attacking anyone, especially foreigners who penetrate their mountain vastness. They have always been thus, and will probably remain so. . . ." Indeed, even their tribal name, Golok, meaning "head turned round" in Tibetan, suggests the rebellious and unruly nature of these people.

As late as 1940 American adventurer Leonard Clark, later an O.S.S. officer in China during World War II, found the Goloks as hostile as ever to invading outsiders. Like Rock, he too launched an expedition up through the desolate grasslands of Qinghai to the Plateau of Tibet in search of Mount Anyemaquen. He called the Golok area (one of the least populated on the globe), "the very citadel of isolation." He first experienced their defiant independence when they massacred thirteen Moslem members of his expedition. The lone survivor was returned to Clark's camp on horseback, "his eyes gouged out, his tongue, ears and nose cut off, his belly filled with mani stones [prayer stones, or pieces of slate inscribed with Buddhist prayers].... His body [was] mounted on a horse tied upright, a grim warning that Tibetans must be consulted on such serious matters as the movement of Moslems and foreign strangers."

Western explorers have long been drawn to Tibet not only by its inaccessibility and the apparent mysteriousness of Tibetan religion but also by the urge "to fill in the white places on the map where no humans but Tibetans had ever been before," as the Swedish explorer Sven Hedin wrote in his turn-of-the-century classic, *Conquest of Tibet*. Ironically, it was not Western explorers like Hedin who finally "conquered" Tibet; rather, it was the Chinese who, claiming suzerainty over it, finally vanquished "the roof of the world."

In the fall of 1950, the People's Liberation Army, honed to battle pitch after fighting the Japanese and Chiang Kai-shek's Nationalists for more than twenty years, began their march to Lhasa. Tibet was not only technologically backward (by 1949 the wheel was still not in wide use) but it also had no army of its own. Among those who put up a fanatical resistance against the Chinese were the various tribes of Goloks on the Tibet-Qinghai border. As Chinese troops attempted to move up the northern caravan route from Xining, the Goloks swooped down on horseback, and on several documented occasions massacred whole units of soldiers.

Of course such resistance exacted heavy reprisals. The Chinese destroyed entire settlements of Goloks living in charis (black yak-hair tents), as well as monasteries and temples suspected of Golok sympathies.

All across Tibet, Chinese "liberation" soon turned into a brutal struggle. And in the process of attacking those aspects of Tibetan society that they viewed as "feudal" and "reactionary," the Chinese ineluctably began attacking the Tibetan Buddhist church and culture at their foundation.

On March 7, 1959, after fruitless negotiations with Beijing, the Dalai Lama, the supreme religious and temporal leader of all Tibetans, fled from Lhasa across the Indian border disguised as a common man. He has not returned. At the time it seemed impossible for a people to become more cut off from the outside world than the Tibetans already were. But with the arrival of the Chinese, Tibet entered a new and more complete period of forced isolation.

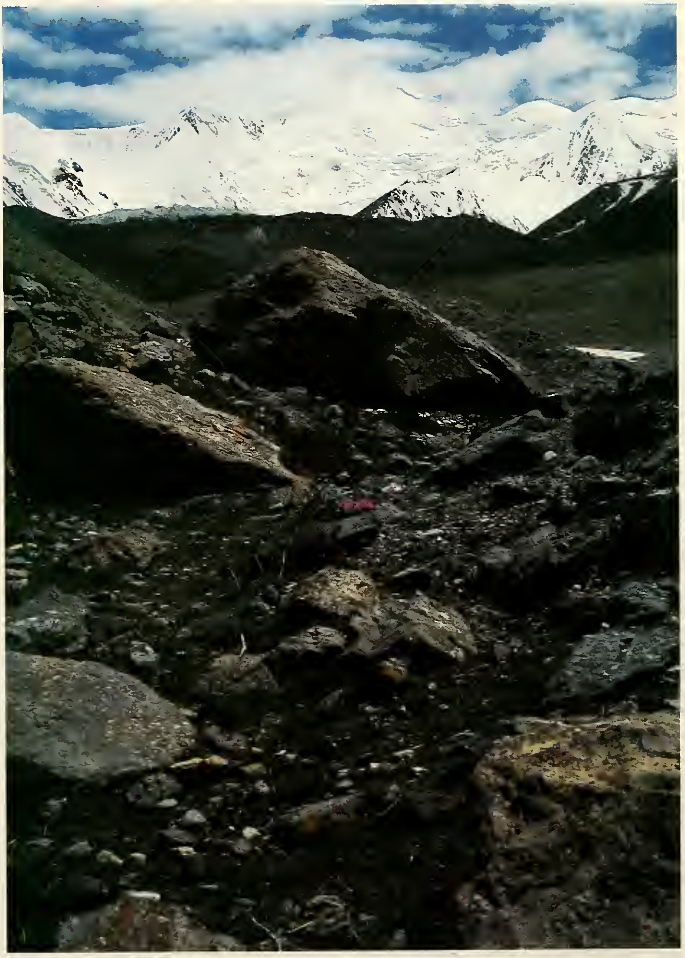
It was against this historical backdrop that our group of Americans and Canadians began a journey across the desert grasslands of Qinghai Province in the summer of 1981, the first expedition of Westerners allowed into this region since 1949. As we moved up into the treeless mountains of the Tibetan plateau, where the barrenness of the landscape is broken only by an occasional Golok tent with prayer flags snapping in the breeze, our sense of expectation was akin to that which early Egyptologists must have felt as they were about to enter a long unopened tomb.

For days we drove by bus and truck through every kind of climate. Sometimes a huge plume of dust, like a miniature tornado, would rise behind us off the parched road. Then suddenly, like a species of alpine hippo, our vehicle would plunge through mud into the freezing cold water of a river ford. Sun, rain, snow, dust, and mud were our alternating companions as we made our way, under the auspices of the Chinese Mountaineering Association, toward Anyemaquen, the sacred mountain deep inside Golok territory. The object of our quest was to retrace the ancient pilgrims' trail around the mountain that had so enthralled explorers like Rock and Leonard. Although neither of them ever succeeded in completing the journey, each erroneously claimed that Mount Anyemaquen, which he saw from a distance, was higher than Everest.

What turned out to be unusual about Anyemaquen was not its height (subsequently calculated at 20,600 feet, considerably lower than Everest), but the reverence with which many Tibetan Goloks still embrace it.

Ever since the fourteenth century, the Goloks have worshiped the spirit moun-

Tattered flags, left, inscribed with prayers believed to be carried heavenward with each breeze, fly over piles of mani, or prayer, stones. The peak of the sacred mountain Anyemaquen rises in the distance, below.



tain and believed that merit for the next life could be earned by circumambulating it from left to right. Each year thousands of faithful would set off on horseback or foot to make the arduous pilgrimage. The most devoted would spend several months, measuring the entire circumference around Anyemaquen (about 120 miles) with their bodies by prostrating themselves inchworm-style on the ground over and over again.

* * *

When we arrive at the base of the mountain, where only a short time ago no foreigner had ever stood, the outside world at first seems light-years away. And yet, as one slowly becomes accustomed to the awesome grandeur of the towering peaks and the strangeness of Tibetan nomadic life, even here one can discern signs of the outside world and the changes it has wrought in the lives of these isolated and once defiantly independent people.

New roads, schools, clinics, small hydroelectric stations, and improved hygienic conditions (which Joseph Rock would have found unimaginable) are everywhere apparent in this new Golok Autonomous Region. But so are the destroyed monasteries, the mani walls (stacks of prayer stones) recycled into stone corrals, the changed habits of dress, and Chinese efforts to organize and collectivize the herdsmen, circumscribing their old nomadic way of life.

* * *

Daejung, the leader of the six Golok yak drivers who will accompany us on our trek, is forty-two years old and lives with his wife and two young children down the river from Snow Mountain. Having forsaken his former avocation as a herder of yak and sheep, he has become manager of a communal deer farm, which does a lucrative business selling deer antlers to central China as an ingredient for traditional Chinese medicine.

What one notices first about Daejung is his Tibetan-style chupa, a long, cloaklike sheepskin garment that is fastened at the

waist with a brightly colored sash. Daejung thrusts his long hunting knife and silver scabbard into the sash like a pirate. But from a distance, the chupa's long, dangling sleeves (into which Daejung pulls his hands in winter) give him an almost simianlike appearance. Whereas the fringes of many Golok chupas are trimmed with snow leopard skin, I notice that Daejung's is edged with polyester velour printed with leopardlike spots.

Since this unusual garment is constructed without any pockets, Tibetans, like marsupials with pouches, keep many of their effects tucked inside the front. They frequently astound the uninitiated by the extensive inventory of things that they can produce from within: a partly eaten leg of mutton, a can of pineapple, cigarettes, rifle cartridges, or a plastic bottle of yak milk yogurt.

On closer inspection, however, one notices how Daejung has been sartorially invaded by Chinese influence. On his head he wears a khaki-colored Mao cap. Beneath his chupa, two grimy Chinese-style tunics serve as underclothes. Protruding from beneath the brightly colored hem of his chupa are a pair of store-bought cotton trousers and a pair of new Warrior-brand basketball shoes, white with bright green rubber soles, that were made in Shanghai. Slung across his back is a Chinese automatic rifle.

With Daejung leading the string of twenty yaks that bear our food and gear, we follow a tributary of the Cheb Chu River along the north side of Anyemaquen. Still not acclimated to the high altitude (10,000 to 16,500 feet), we are left gasping for breath as we move up the first steep pass. Never have I encountered weather that changes so quickly and unpredictably. One moment the sky is blue and the sun is baking down on us as we climb. Then I become lost in thought for a few moments, only to look up and see that the sky has suddenly changed. A storm is boiling down the valley. A wind suddenly arises. I look over to where a towering peak stood and see nothing but billowing white fog and clouds.

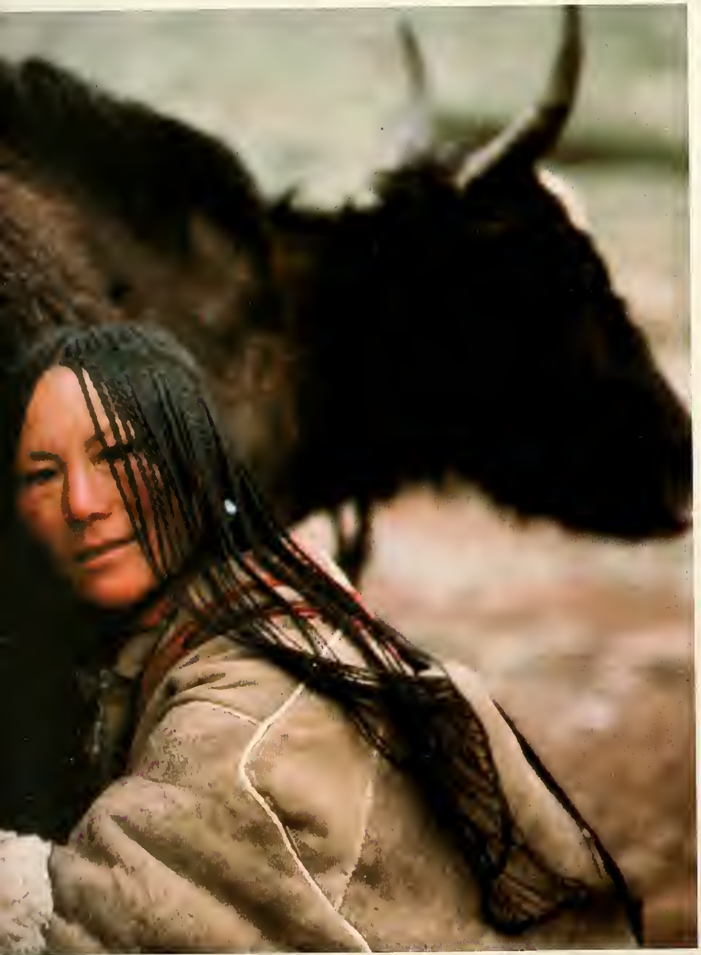
As we leave camp and move up the Ye-Khog, or Right Hand Valley, snow, which began during the night, continues to fall. The only landmarks in the blank whiteness are occasional lab-tse, cairns of rock piled up on top of boulders as offerings by previous pilgrims. Otherwise, all distinctions, even the division between the land and sky, have been obscured by the falling snow. The vastness of the mountain landscape is shrunk by the disorienting whiteness.

Not until I reach the top of the pass do I spot the yaks and Daejung. He is standing on a rocky, windswept ridge, overlooking a rolling valley on the other side. It is called Place of a Thousand White Tents, because it was here that thousands of pilgrims once pitched their white cloth tents before ascending the pass the next day.

As I approach, Daejung suddenly remounts his horse, wheels around, and giving a cry that is half sung and half shouted, charges up a snowy incline. I clamber up behind him, and there on a rocky crest at the very summit of the pass are banks of prayer flags hung from yak-hair halyards on rough juniper-wood posts. Each flag is inscribed with a prayer that is believed to be transmitted heavenward with each flutter in the wind.

Like spars of a phantom ship trailing tattered sails, the prayer flags whip and snap in the brisk cold wind. Beneath them lie banks of mani walls and piles of prayer

Yaks, heavily laden with the expedition's baggage, are kept moving by their Golok drivers, left. A Golok woman, below, wears her hair in 108 separate braids—108 is considered a holy number.



stones, each inscribed over and over with the sacred incantation *Om Mani Padme Hum*, "Oh the Jewel in the Hand of the Lotus." Referring to Buddha, who is said to have been born in a lotus blossom, the chant is repeated tirelessly, like Hail Marys, by the Tibetans.

Under the somber sky, there is a ghost-like majesty to this open-air cathedral, whose religious power derives not so much from the primitive monuments that men have erected to the spirits as from the grandeur of the surrounding natural landscape.

"Each year in the old days thousands and thousands of pilgrims used to make the trip around Mount Anyemaquen," Daejung announces, almost like a tour guide. "But then the Chinese came, no one dared worship or even hang prayer flags out around their tents. Everything old was considered bad and could get a person into trouble." He gives a nervous laugh, and glances toward the lone representative from the Chinese Mountaineering Association who is accompanying us.

"But in 1979, after the fall of the Gang of Four, in the earth-sheep year, thousands of pilgrims appeared around Anyemaquen again. Even to the old people it was a surprise."

* * *

If it were not for the wisps of smoke, visible in the distance only for a moment before they are caught on the wind and erased, the gray tent by the river just after Gos-sku-chhem would appear like nothing more than another large boulder. But as we come up the valley and draw closer, I can just make out a group of tethered yaks and the figure of one lone man staring at the approaching phalanx of Caucasians wearing brilliant red, blue, green, and orange parkas, hats, and wind pants.

"Pilgrims," says Daejung bluntly, and then rides forward to greet the bewildered man. These are the first pilgrims we have seen.

How Daejung is explaining our presence to the perplexed pilgrim, I do not know. But as they are talking, I notice the tent flap behind them open and then immediately close again like the shutter of a camera. The sound of agitated voices comes from within.

After a moment, the tent flap slowly begins to open again, and I catch a fleeting glimpse of several female faces before they see us and reflexively pull the tent flap down once again.

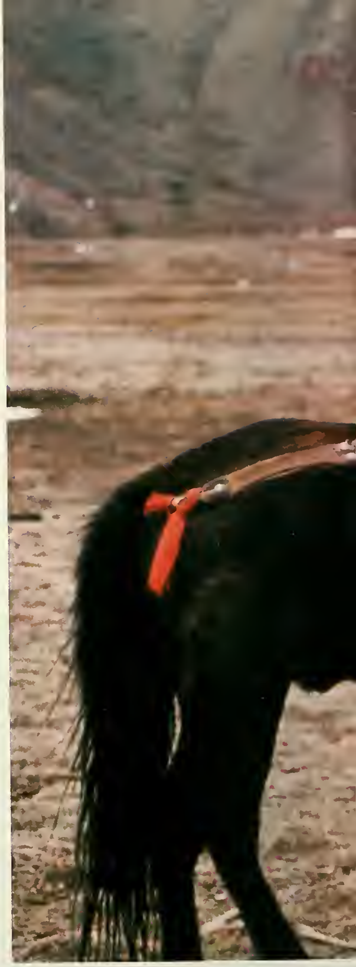
Finally, curiosity having triumphed over fright, the flap opens wide and the women shyly step outside the doorway and stand staring in mute fascination.

They are dressed in long robes encrusted with silver jewelry and coral ornaments and wear yak-hide boots with pointed toes. Their black hair is meticulously arranged in scores of tiny braids that cascade thin as veins down their shoulders and are joined like a bridal train behind them.

The oldest woman clutches prayer

Although an endangered species, snow leopards are hunted by the Goloks, right, who sell the animals' bones for use as medicine. A mural over the doorway of a state-run store, below, depicts animals sought for medicinal purposes.

各种中药
國营
东大亍中药材收購門市部
下午六時



beads in her rough, chapped hands. As she watches the strange spectacle of our foreign troupe, which in contravention of Tibetan Buddhist tradition has mysteriously chosen to circle Anyemaquen in the wrong direction, the beads pass ceaselessly through her fingers and she mutters prayers. For while Tibetans always pass around holy places from left to right, we have chosen to navigate around Anyemaquen from right to left, in order to avoid climbing a very high pass on our first day out. We are performing what to these pilgrims is an act of absurdity. The notion that we might be trekking around the mountain as a form of recreation is obviously not even imaginable to the women before us.

Turning to me and speaking in his guttural brand of Chinese, Daejung explains, "This man tells me that the family wished to make the pilgrimage around Anyemaquen before the old lady in the tent dies." Daejung gestures to the eldest woman standing in the doorway. "The other men are all across the river at a mani wall making offerings. I think we should leave before they return." Daejung looks around nervously.

Whether he fears our intrusion on this pilgrimage will provoke a hostile reception from the absent men or whether he is simply uneasy about his position in the vortex of two such dissimilar worlds, he does not say. But suddenly he is pointing down the valley. About a half mile away, where the river fans out into a rocky ford, I can just make out five horsemen. They are galloping across the shallows, spray from the animals' hoofs exploding around them as they charge toward the shore.

As we hasten away, the oncoming horsemen near the camp. For the first time since our arrival among these Tibetan nomads, my mind involuntarily summons forth accounts of the earlier explorers who had found the Goloks so bloodthirsty and inhospitable.

"They bring terror to the hearts of all their neighbors and travellers," I recall Joseph Rock having written in a work that even now is packed in my gear on one of our yaks. "A caravan of foreigners incites wild curiosity and the pleasant anticipation of robbing him to find out what treasures he carries and to come into their possession."

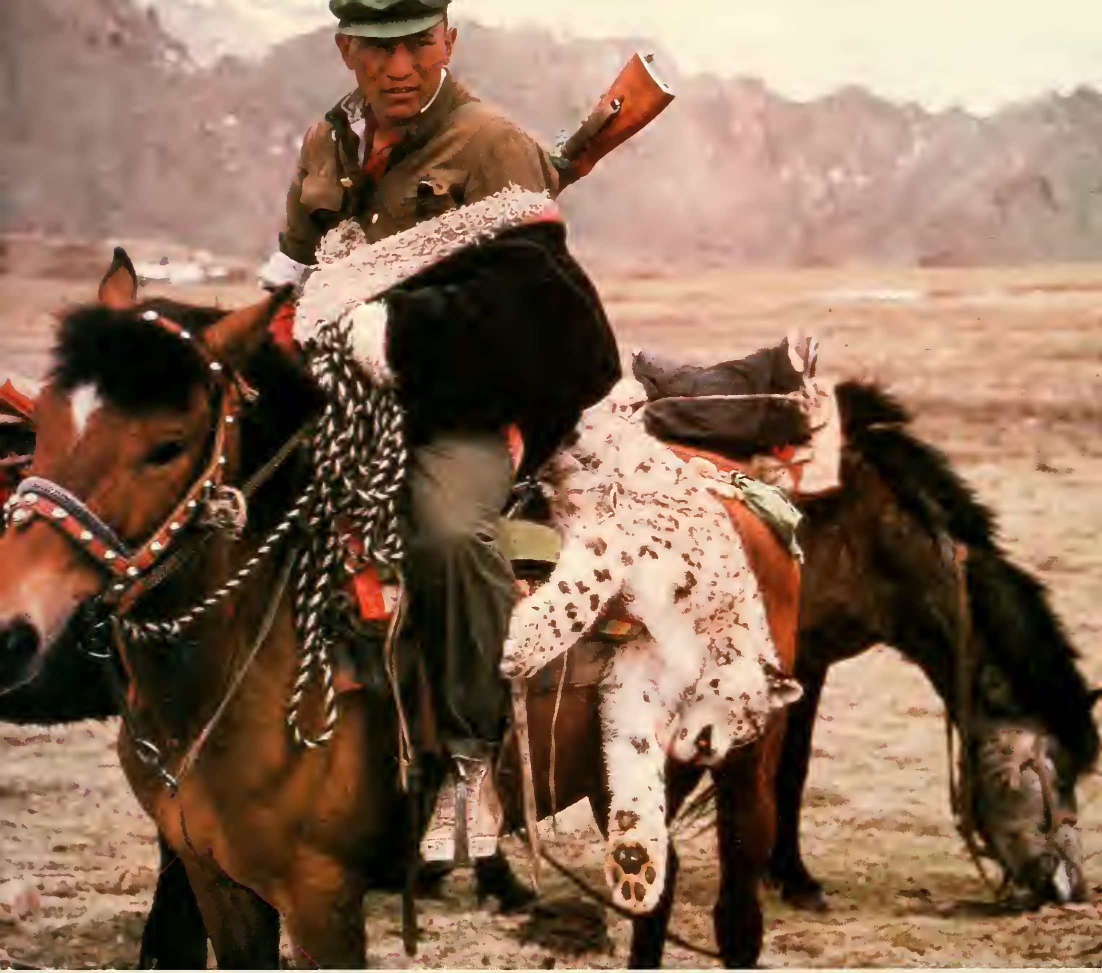
For an instant, the menacing approach of these horsemen makes me wonder if perhaps they are not coming after *us*, to rid their homeland of yet another generation of intruders! As we move up to a rise through a field of boulders, I pause and glance back. In the distance I see the men, still on horseback, standing in front of their lone tent looking after us. Two of them are waving genially in our direction.

* * *

Today, at last, is a rest day. We are camped in a vast open meadow on the south side of Anyemaquen in the Yon-Khog, or Left Hand Valley. The mountain's snowy peaks are silhouetted against the cobalt blue sky like teeth of a saw.

While I am looking forward to a day of relaxing and washing my clothes and hair, the Goloks are eagerly preparing to go hunting.

Several hours after they have ridden out of camp, bandoliers strapped around them, the sound of a distant gunshot wakes me from a snooze. My reveries are disturbed again by the sound of approaching hoofs accompanied by yelping noises



that sound as if Indians are attacking us.

Looking out through the door of our tent, I see the Goloks sweep back into camp, their horses sweating and breathing hard. Daejung fairly springs from his saddle. Tsambu, a swarthy young man in his twenties, stays mounted on his excited steed, all the while making ecstatic noises that sound like a cross between a crowing rooster and a yodel. Draped just behind his saddle like a bedroll is the lifeless body of a snow leopard.

As Tsambu's horse prances in place, the leopard's head rolls slackly back and forth, eyes still wide open, blood dripping down one lip, and a pink tongue hanging limply out between its ivory white teeth. All the taut feline grace has left the cat's body, so that it looks like little more than a skin filled with sand. Far from appearing fierce, the animal looks frail and delicate.

"Not only are snow leopards dangerous, but they eat sheep and young yaks," says Daejung somewhat defensively, perhaps noticing the pall that this dead animal's presence has cast over the foreign onlookers. "The State will also buy their bones," he continues. "We can earn as much as 100 yuan [$60.00]. The Chinese use snow leopard bones for their medicine. They put a small piece into a bottle of wine. They say it is good for old people."

Then Tsambu unties the snow leopard and lets its dead body slide to the ground. Holding their weapons, the Goloks take turns posing with the leopard in various heroic postures. Then they stack their rifles, draw their hunting knives, and commence to skin the animal.

They cut off its floppy, oversized paws, which gave an almost kittenlike appearance to this young cat. Then, slitting the still-warm body from the chin to the end of its tail, they flay the pelt as if they were peeling a grape. Without its plush fur, the bare carcass appears thin and reptilian. The naked pink tail bears no resemblance to that of a leopard, but instead looks as if it might have belonged to an exotic species of opossum.

Like gamblers goaded on by the promise of another jackpot, Daejung and some others ride back out to continue the hunt. When I enter the cook tent at dusk for dinner, there is another headless carcass slumped by the doorway. This time it is a blue bharal sheep.

For the next several days we dine on snow leopard soup and stir-fried blue bharal sheep. I cannot eat without being reminded that in the thirty short years since the Chinese Communists first occupied these Tibetan grasslands, the huge

The nomadic Goloks, whose ferocity was once legendary, now face an uncertain future as their culture and religion are slowly eroded by Chinese domination and the outside industrialized world.

herds of wild yak, mountain sheep, ass, and gazelle and a bountiful population of bear and leopard have been all but extinguished. So fixated have the Chinese been on politics that they have hardly noticed the destruction of the natural world around them. In fact, they have abetted it by allowing the lucrative trade in such rare animals as the snow leopard, the Himalayan brown bear, and the white-lipped deer (used respectively for their bones, livers, and antlers in traditional Chinese medicine) to continue.

After we have returned from the Tibetan plateau, I stumble across a state-run store in downtown Xining that traffics in these medicinal ingredients. On a busy street above a small shop I spot a hand-painted mural depicting a bevy of endangered mountain animals gazing out over the crowded sidewalk from a lush meadow. A placard just beneath the mural identifies the shop as the East Main Street Store for the Purchase of Chinese Medicinal Ingredients. Lest a Tibetan nomad fail to get the point, another sign proclaims in both Tibetan and Chinese, This Store Buys All Kinds of Ingredients for Chinese Medicines.

Having traveled more than ten thousand miles by jet aircraft and then come another week by train, bus, and truck to reach Anyemaquen, my environmentalist's indignation over the killing of these animals seems somehow misplaced. Melancholy seems a more fitting response for observers, such as ourselves, who have hopped from continent to continent with such insouciance in search of unsullied wilderness only to be confronted with the irony of dead snow leopards.

But there is another, equally disquieting irony: it is the Goloks who have presided over the demise of these doomed animals. And, aware of it or not, they too are an endangered species whose culture and religion are slipping away.

Looking at Daejung and his comrades, it is hard to imagine that only three or four decades ago they had terrorized explorers like Joseph Rock and Leonard Clark who had come in search of an unknown mountain said to be higher than Everest. Now their defenses against intruders have gone slack. Assaulted first by Chinese bringing the militant message of Mao's Communism, and now open to expeditions, such as ours, from the outside industrialized world, the Goloks can no longer rely on the protection their unique mountain geography once afforded them. And like the snow leopards they hunt, the Goloks' traditional nomadic way of life will soon vanish from the face of the earth. □

Masters of the Tongue Flick

Food seeking, sex recognition, courtship, and the detection of predators are but some of the reasons why lizards stick their tongues out

by Carol A. Simon

Tom Brakefield; Bruce Coleman, Inc.

Many lizards, like many snakes, often stick out their tongues. Some simply flick their tongues into the air, while others touch the ground with their dexterous appendages. This behavior fits in well with some popular stereotypes of things reptilian: the flicking tongue connotes mystery, danger, and sinister forces. The truth about tongue flicking is much more mundane. Several years ago my colleagues and I began a series of field and laboratory studies aimed at answering two fundamental questions: What do lizard tongue extrusions accomplish, and why do some species stick out their tongues continually while others do so only once or twice an hour, if that frequently?

Several obvious answers come to mind. Lizards certainly use their tongues to manipulate food and water, but lizards also flick their tongues into the air, and those that touch their tongues to the ground do so at the same rate whether or not food and water are present. Tasting is a possible reason, but most lizards have few taste buds and these are usually located at the back of the throat. Taste is believed to be a relatively unimportant sense in lizards.

Lizards and snakes are closely related, and since many snakes do a great deal of tongue flicking, some knowledge of how they use their tongues is helpful in determining why lizards stick out theirs. When a snake flicks out its tongue, airborne chemicals adhere to its moist surface, and as the tongue is retracted into the mouth, it slides across the palate, where small slits open to the vomeronasal, or Jacobson's, organs. These paired chemosensory organs are completely hidden by the palate, and the molecules brought in by the tongue are swept by cilia through the slits and into the organs. A nerve, the vomeronasal, leads directly from the Jacobson's organs to the brain, so that information concerning the nature of the chemicals can then be processed by the central nervous system. Lizards also have paired Jacobson's organs, which are well developed in some species but poorly developed in others. Although few physiological studies have been done on these organs in lizards, they seem to function similarly to those found in snakes. (In both snakes and lizards smell is a completely separate process.)

Studies suggest many possible functions for the lizard vomeronasal system. Consider the Gila monster, the only poisonous lizard in the United States. Gila monsters use their vomeronasal system to find food. In separate tests, two investigators dragged a mouse and a pigeon egg along a surface so that chemicals from the food items would remain on the ground. Gila monsters traced the mouse or egg by touching their tongues repeatedly to the pathway. Even when the mouse was in clear view, the Gila monsters still followed the chemical trail. Gila monsters exhume and eat the eggs of other reptiles; tongue extrusions may help locate them.

While some lizards use the vomeronasal system to find food, many seem to use this system for different reasons. For example, my studies of the behavioral ecology of Yarrow's spiny lizard, most of which were done at the American Museum of Natural History's Southwestern Research Station in Arizona, show that this animal does not use its tongue for food seeking; only one of more than 2,800 tongue extrusions immediately preceded feeding. This lizard is primarily a sit-and-wait predator, as opposed to an active searcher. It perches on a

With a quick flick of its sizable tongue, a Jackson's chameleon, left, has captured an insect for its meal. The Gila monster, above, used its tongue to locate a clutch of quail eggs, on which it will dine.

Zig Leszczynski; Animals, Animals

NATURAL HISTORY MAGAZINE

SAVINGS CERTIFICATE

For *FOR THE SUM OF 9 DOLLARS*

This savings certificate saves you $9.00 off the single copy rate for 1 year on new subscriptions or renewals (12 beautiful and thought-provoking issues) of NATURAL HISTORY magazine, including membership in the American Museum of Natural History and all the benefits that go with it. As soon as we receive your order, we'll start your subscription and send your membership card.

☐ **YES,** Please send me a full year of Natural History at the low rate of $15 for 12 issues including Museum membership

☐ I want to save more. Send me 2 years of Natural History (24 issues) which includes membership for only $26 (a $22 savings off the single copy price).

☐ New ☐ Renewal

Name ______________ (please print)
Address ______________
City ______________
State ________ Zip ________

☐ Payment enclosed ☐ Bill me later
Charge my ☐ Visa ☐ MasterCard
☐ American Express

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
Account number

Send gift to: J559

Name ______________ (please print)
Address ______________
City ______________
State ________ Zip ________

Gift card to read ______________ ☐ 1 year $15 ☐ 2 years $26

Signature ______________

Moneyback guarantee if not satisfied.

Please add $5 per year for postage outside the USA. Payment must be included.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

POSTAGE WILL BE PAID BY ADDRESSEE

NATURAL HISTORY
P.O. Box 4200
Bergenfield, N.J. 07621

Male chuckwalla lizards use their tongues during courtship. They touch many areas of a female's body and may ascertain her sex by detecting the presence of certain chemicals.

Carol A. Simon

favorite rock for hours, darting out to capture any food that appears, watching for predators, chasing away unwelcome members of the same species, and watching for mates during the breeding season. The lizard uses its tongue for other purposes as well as for feeding and drinking. I once thought that perhaps tiny insects were being captured as the tongue touched the rocks, but a careful search of the rocks, plus an examination of the stomach contents of several lizards, convinced me otherwise. I also searched carefully for small drops of water and found the rocks to be perfectly dry.

Since many lizard species frequently stick out their tongues when they are not looking for food, we can assume that some other type of information is being obtained. In particular, the tongue may help some lizards in sex or species recognition. Male western banded geckos, for example, respond to a chemical stimulus emanating from the skin of the female. This stimulus may serve to attract males to females and to help differentiate males from females. One investigator exposed courting male banded geckos to partly anesthetized males and females that had their tails surgically exchanged. Males often touch their tongues to various parts of the female body, and normal courtship involves biting and holding the tail of the female. Courting males in this experiment rarely gripped male parts. In several cases, males gripped and held the female tail on male individuals. Other male lizards, such as the side-blotched lizard and the large chuckwalla, both found in the western United States, also touch their tongues to females during courtship. The side-blotched lizard often samples the flank and groin areas while the chuckwallas touch many areas of the female body.

Maternal behavior may also be aided by the vomeronasal system. Few reptiles exhibit any sort of maternal behavior, although there are some obvious exceptions such as female alligators, which defend their nests as well as the hatchlings, and pythons, which incubate their eggs by coiling around them. A few lizards also exhibit minimal maternal care, and such care may sometimes be aided by information brought in by the tongue. Broad-headed skinks often lick and turn their eggs and may even spend time brooding them. In one experiment, when eggs of different kinds of lizards were substituted for skink eggs, females refused to incubate many of them; varnished and waxed skink eggs were ignored as well. Since the investigators could not rule out the role of smell in this experiment, they suggested that broad-headed skinks may use some combination of smell and the vomeronasal system to recognize their own eggs.

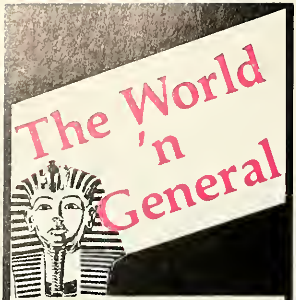
For some lizards, recognition by males through tongue flicking of chemicals produced by females may help insure that mating occurs between members of the same species. The vomeronasal system helps adult lizards recognize others of their species for nonmating purposes too. For example, newly hatched green iguanas extrude their tongues at the nest opening prior to complete emergence. Once outside, juveniles proceed slowly while touching their tongues to the ground and other hatchlings. At this age these animals are gregarious and investigators believe that detection of telltale chemicals through tongue flicking may help the young iguanas stick together.

The chuckwalla in California may actually mark the substrate with secretions. These markings could then indicate to a lizard that another member of the same species lived there. Such markings would also help to delineate territorial boundaries. Snakes that prey on lizards might be detected in a similar manner. If snakes are depositing chemicals so that members of a single species can find or avoid one another, lizards may have evolved the ability to chemically detect the presence of snakes.

Thus the vomeronasal system has been implicated in food seeking, sex recognition, courtship, species identification, orientation, maternal behavior, territorial behavior, and predator detection. Many of these observations and studies are anecdotal, however, and need to be tested in a quantitative and controlled manner for various species. Since none of the studies had thoroughly investigated the reasons for tongue extrusions by a single species, my research team decided to examine in greater depth the role of the vomeronasal system in Yarrow's spiny lizard. Karen Gravelle and Barbara Bissinger, then doctoral candidates at the City University of New York, worked closely with me on this project.

We began by determining that the mean number of tongue extrusions for males and females, be they juveniles or adults, is approximately ten an hour. Under certain circumstances, however, tongues are extruded far more frequently. For example, these lizards touched their tongues to the substrate (rocks, logs, trees, or the ground) an average of twenty-six times in the hour following morning emergence, and lizards removed from their home ranges extruded their tongues thirty-one times each hour. This increase of two and one-half to three times the normal rate of extrusions indicates that Yarrow's spiny lizard uses its tongue to monitor certain chemical changes in the environment. We suggest that these animals are monitoring their chemical environment most carefully when they first emerge in the morning and when exploring new areas.

But what types of chemicals are being monitored? As suggested earlier with chuckwallas, there is a distinct possibility that lizards are monitoring chemicals that reveal the presence of other members of the same species. Pheromones deposited by conspecific lizards may help to mark territories and/or assist in finding individuals for mating. Laboratory experiments showed us that the incidence of tongue flicking increases significantly when Yarrow's spiny lizards are placed in empty cages where other members of the species once lived. This increase, which is found in newly born lizards as well as adults, suggests that the lizards find something interesting on the substrate, presumably pheromones deposited by other lizards, and continue to explore this information with their tongues. Yarrow's spiny lizards are territorial but do not constantly guard their territories. A chemical marking system could identify well-established territories for a newcomer even when no visual cues are available.



GENERAL TOURS
TAKES YOU TO
EGYPT
ECONOMICALLY!

9–17 Days from $1629*
includes Air Fare

THE ONLY WAY TO GO...
THE RIGHT PRICES...
THE RIGHT WAY...

THE GENERAL TOURS WAY!

Tour Features Include:
- First Class 4 or 7 Day Nile Cruises
- Deluxe Hotels throughout
- American Tour Manager

*All prices per person double occupancy from N Y Single supplements available

ASTA USTOA
Member First Family of Travel

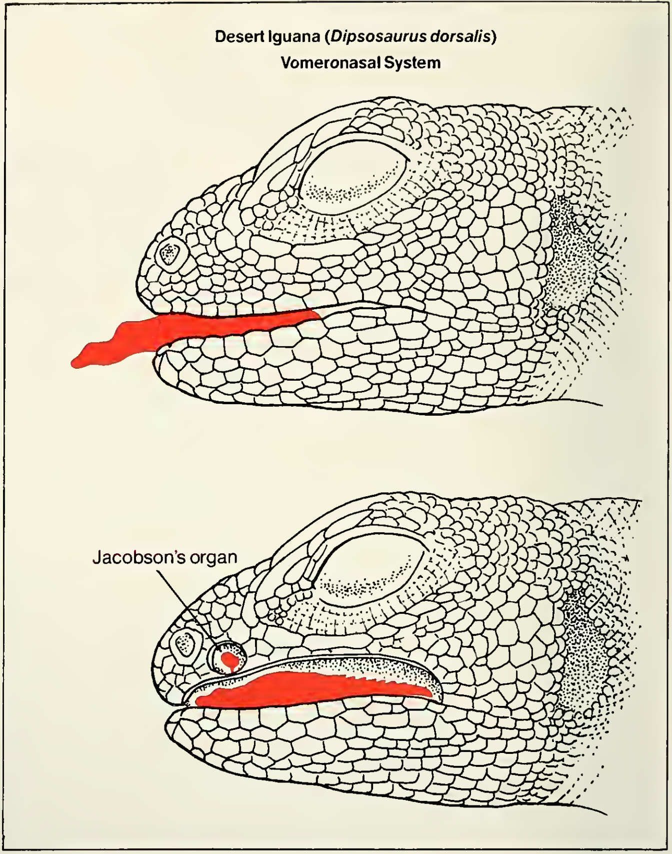
What A Way To Go!

GENERAL TOURS, INC.
711 THIRD AVE.
NY, NY 10017
212-687-7400
NHE 9/82

Please send my free copies of:
☐ Russia ☐ China ☐ Egypt ☐ Scandinavia
☐ Kenya ☐ Holyland

name ____________
address ____________
____________ zip ______
my travel agent ____________
____

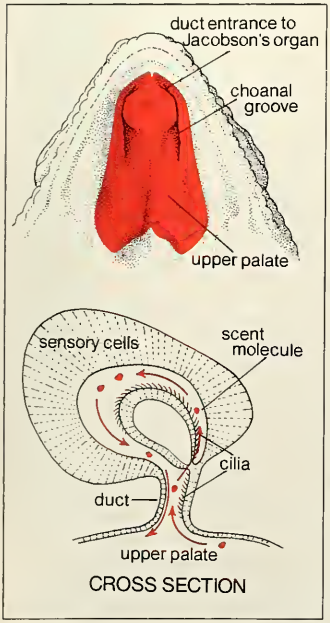
Frances Zweifel


Desert Iguana (*Dipsosaurus dorsalis*)
Vomeronasal System

By focusing on the relationship of tongue extrusions to mating, Karen Gravelle has obtained good evidence that pheromones exist. In her experiments, four adjoining outdoor pens were constructed. Three pens housed one lizard each: an adult male, an adult female, and a juvenile male. The fourth was left empty, as a control. The residents were taken out during testing periods, but remained in their home pens at all other times. Adjoining pen walls were removed to make one large pen during the thirty-minute testing periods, and fifteen adult males, one at a time, were placed in the center of the pen. The incidence of tongue extrusions increased when the males entered the area where the adult female had resided. One male stopped at the female's favorite perch site and thoroughly explored this area with his tongue. These observations provide evidence that males chemically detect the presence of females during the mating season. Since individual Yarrow's spiny lizards are not continually active, a male that discovers a fresh chemical deposit from a sexually receptive female might remain in the area until she emerges again. Once the female emerges, vision becomes the dominant sense involved in the mating process.

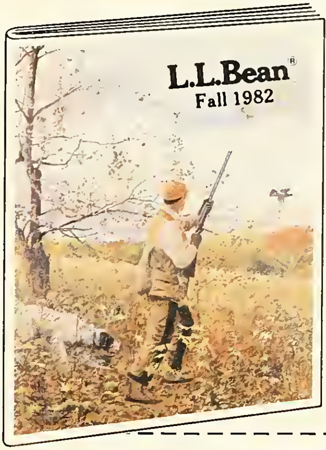
Although Yarrow's spiny lizards can chemically detect other members of their species, the source or sources of the pheromones are still uncertain. Several possibilities exist. Many lizards, Yarrow's spiny lizard included, often rub their chins on the substrate. They may have itchy chins or they may be depositing a pheromone. Histological studies have not revealed any external glands along the chin of Yarrow's spiny lizard, but the mouth, just inside the lip line, is loaded with glands. Substances from these glands may exude from the mouth and then be rubbed by the chin onto the substrate. Interestingly, the males in Gravelle's study exhibited more defecations and pelvic rubs in the female's home pen than in any of the other three pens. These could be ways to mark an area. Many lizards have large pores along the inside of the femur, and these may secrete substances that can be deposited by pelvic rubbing. In addition, many glands exist in the vicinity of the cloaca (the single reproductive and excretory opening), and pelvic rubbing can smear glandular secretions, as well as urine or feces, onto the substrate. David Duvall of the University of Wyoming found that cloacal exudates of both male and female western fence lizards (which are closely related to Yarrow's spiny lizard) elicit tongue extrusions. The lizards may not even have to make an effort to mark an area; resting the cloaca or femoral pores on the substrate may automatically result in the application of chemicals.

One thing that particularly intrigued us was the low rate of tongue extrusions by Yarrow's spiny lizard compared with that of other species of lizards. Why do some species flick out their tongues more than others? Barbara Bissinger initiated a study in which we examined rates of tongue extrusions for fourteen species representing six taxonomic families of lizards. All were observed under similar laboratory conditions, some at the Bronx Zoo, some at the American Museum of Natural History, and some at our City College laboratory. In a laboratory setting, Yarrow's spiny lizard, a representative of the family Iguanidae, extrudes its tongue approximately sixteen times each hour—not statistically different from the mean rate of ten times



Frances Zweifel

L.L.Bean®



FREE
Fall Catalog

Fully illustrated. Features quality apparel and footwear for men, women and children; camping, hunting, hiking and winter sports gear.

For 70 years L. L. Bean has offered practical and functional merchandise at reasonable prices. Many items of our own manufacture; all guaranteed 100% satisfactory.

☐ SEND FREE CATALOG

Name__________

Address__________

City__________

State__________Zip__________

L. L. Bean, Inc., 751 Casco St., Freeport, ME 04033

UNIQUE TURNER OFFER

A First Rate taking in Stores.
Signed "J M W Turner 1818" (19 x 17 in.)

Superb quality print of a very beautiful Turner watercolour. Art historian B.L. Binyon wrote in 1909, "This is Turner at the peak of his powers, his palette is positively translucent." The original is in a private collection in England, and has rarely been seen since 1819, when it was exhibited at Grosvenor Palace.
A few hundred copies were printed to commemorate Turner's bicentenary. We have every one of them. There will be no more available once these few are gone.

Print $15.50 (Framed $59.50)

Calif. residents add 6½% tax
OXFORD GALLERIES
2210 Wilshire Blvd., Suite 627
Santa Monica, CA 90403 (213) 452-2443

Name

Address

City State Zip

☐ M C ☐ Visa Credit Card Number Exp

LEARN PROFESSIONAL PHOTOGRAPHY at home.

Would you like to see your pictures in magazines like this? For 70 years, NYI has trained amateurs to take professional pictures—pictures that get published, win prizes, even lead to a new career. If you love photography, NYI can make it happen for you too.

You'll learn at home in your spare time, with our new "Voice-on-Tape" method that guides you easily through magnificent portfolio-size lessons, illustrated by salon-quality photos of world-famous masters. A remarkable course at surprisingly low cost. Call or send for free informative booklet. No obligation.

Mail coupon OR CALL TOLL FREE 800-453-9000

Yes! Send me the free color booklet about the NYI Course. No obligation. No salesman will call.

Name __________

Address __________

City/State/Zip __________

☐ Under 18, check here for special information.

New York Institute of Photography
Dept. N92 880 Third Ave., N.Y., N.Y. 10022

The Questers Program for Fall & Winter 1982

Stimulate your mind on a Questers nature tour.
We search out the plants and animals, birds and flowers...
and explore rain forests, mountains and tundra, seashores,
lakes and swamps. There is ample time to photograph, absorb, reflect.
Naturalist guides, small tour parties, first-class accommodations.

Worldwide Nature Tours Fall & Winter 1982 Departures

The Americas

Everglades: 11 days, Nov. 4, Apr. 7 • Hawaii: 15 days, Oct. 10, Dec. 19, Feb. 10, Mar. 24 • Southern Mexico: 14 days, Dec 19, Feb. 13 • Panama & Costa Rica: 14 days, Dec. 18, Feb. 12 • The Amazon: 17 days, Oct. 10, Nov. 14, Jan. 9 • Ecuador and Galapagos: 15 days, Oct. 28, Dec. 30, Feb. 10 • Peru: 17 days, Nov 6 • Patagonia & Tierra del Fuego: 21 days, Nov 6, Jan. 10 • Trinidad & Tobago: 11 days, Nov. 8, Mar. 7.

Asia & Africa

The Himalayas: 23 days, Oct. 7, Mar. 17 • India: 23 days, Oct. 30, Jan. 29 • Sri Lanka: 18 days, Nov. 19, Feb. 18 • Kenya: 23 days, Oct. 21, Feb. 3.

Australasia

Australia & New Zealand: 30 days, Oct. 2, Feb. 12 • New Zealand & Milford Track: 22 days, Nov 12, Feb. 11.

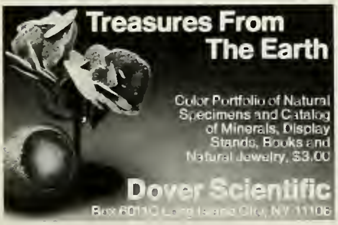
New & Special Tours

We will also be offering in 1983 a number of new and special tours. Among them are:

- New Guinea
- Walking in the Foothills of the Western Himalayas
- Japan
- Madagascar/Réunion/Mauritius
- Okefenokee Swamp & Georgia's South Coast

Write or call today for your complimentary Directory of Worldwide Nature Tours and to be placed on our mailing list. If you are interested in a particular tour, please request its Detailed Itinerary.

QUESTERS
Questers Tours & Travel, Inc.
Dept. NH, 257 Park Avenue South
New York, NY 10010 • (212) 673-3120



Treasures From The Earth

Color Portfolio of Natural Specimens and Catalog of Minerals, Display Stands, Books and Natural Jewelry, $3.00

Dover Scientific
Box 6011C Long Island City, NY 11106

The Wilderness Travel World of Discovery

FALL/WINTER NATURE TOURS to:
• Nepal • Kenya • Tanzania • • Costa Rica • Galapagos • The Amazon • Ecuador • Peru • New Zealand •

Expert naturalist leaders *Very small groups*
Write for free illustrated catalog

WILDERNESS TRAVEL
1760-NB Solano Avenue, Berkeley, CA
(415) 524-5111 94707

Natural History Nice'n Neat

Slip your **Natural History** issues into permanent files for ready reference. Green leather-like face embossed in gold to look like fine books. It holds one year's subscription. Also for **Smithsonian**, blue, 1 year. **Audubon**, green, 1 year, **Scientific American**, red, 1 year, **National Wildlife**, blue, holds 3 years. Specify title and quantity. Postpaid

$5.20 ea. $4.63 ea., 3 or more.

Send check or Master Charge or VISA number with exp. date, signature to

Highsmith
P.O. Box NAT 25 Ft. Atkinson WI 53538
Catalog of files free with order

MATH WITHOUT TEARS

Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written.

Learn math in the comfort of your own home at minimum cost.

Order Now: $11.95 plus $1.25 hdlg
EMERSON BOOKS, INC.
Dept. 595-G, Verplanck, NY
10596
10 Day Money Back Guarantee

per hour that we observed in the field. Both values represent relatively infrequent use of the vomeronasal system. A second iguanid, the neotropical tree lizard *Enyaliosaurus clarki*, extrudes its tongue approximately twenty-six times each hour. Contrast these relatively low rates of tongue extrusions with those of two Australian members of the family Scincidae, the common blue-tongued skink and the blotched blue-tongued skink. The common blue-tongued skink extrudes its tongue an average of 257 times each hour; the blotched blue-tongued skink, 330 times each hour. If these rates seem extraordinary, consider these three members of the family Teiidae: the western whiptail flicks out its tongue an average of 456 times each hour; the checkered whiptail, 623 times per hour; and the Chihuahua whiptail, more than 700 times an hour.

Flicking out the tongue hundreds of times each hour takes considerable energy and probably results in some water loss through evaporation. This behavior must therefore serve some purpose. Whiptail lizards must rely heavily upon the information brought in by the tongue for many aspects of daily life. Smell also seems to be important for these lizards, which often sniff in a manner similar to that of humans. At the other extreme, iguanids such as Yarrow's spiny lizard rely much less on information gathered by the tongue. The skinks, showing an intermediate incidence of tongue extrusions, form an intermediate group.

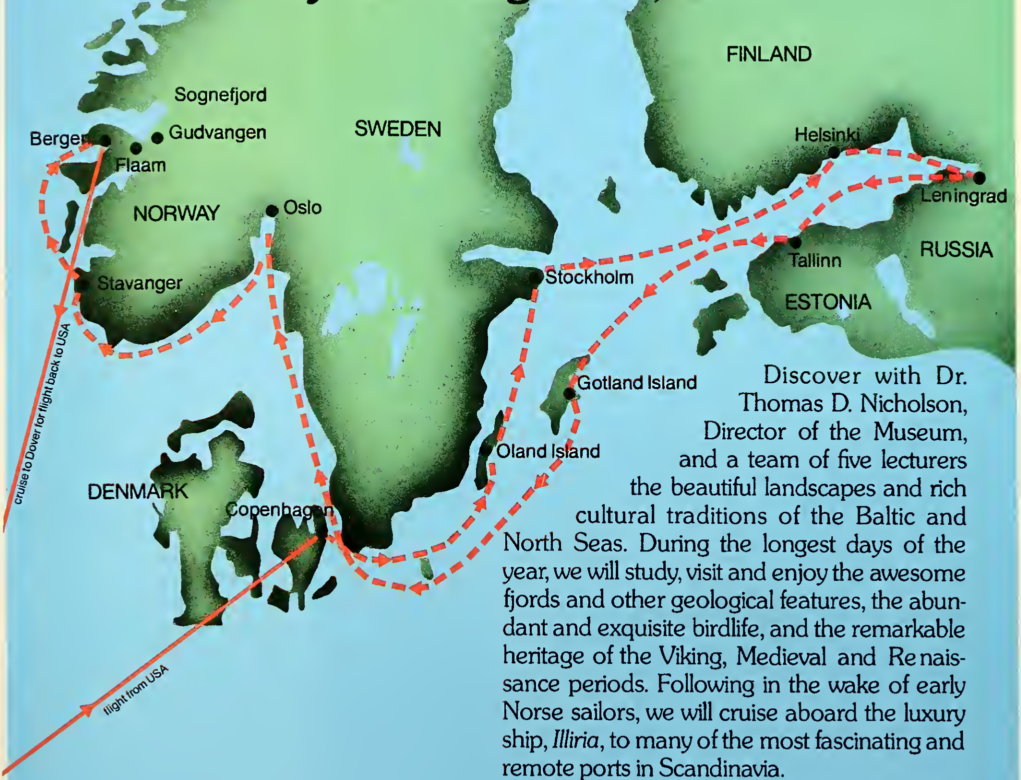
Most iguanid lizards are colorful, highly visible, and exhibit obvious behavioral displays. For example, territorial behavior for the dark Yarrow's spiny lizard involves slashing its blue tail from side to side, exposing bright blue sides by flattening its body, presenting these sides to an intruder, hopping sideways, doing push-ups, and extending a bright blue gular area under the chin. These animals spend a great deal of each day basking and waiting for food to come to them, and all these activities make them highly visible to other iguanids. The Jacobson's organ is reduced, but functional, and the tongue is broad and fleshy. The function of the vomeronasal system is important, but vision is the dominant sensory system.

Skinks are less visually oriented and show various stages of reduction in eye size, as compared with other lizards. Skinks are relatively secretive and hard to find. Rather than spending the day sitting on visible perches waiting for prey, they actively search for food, often under cover. Basking is infrequent. They seem to rely more upon chemical signals to find or

The American Museum of Natural History

Scandinavian Saga

July 28 to August 15, 1983


FINLAND
Sognefjord
Bergen
Gudvangen
Flaam
SWEDEN
Helsinki
Leningrad
NORWAY
Oslo
RUSSIA
Tallinn
Stavanger
Stockholm
ESTONIA
cruise to Dover for flight back to USA
Gotland Island
Oland Island
DENMARK
Copenhagen
flight from USA

Discover with Dr. Thomas D. Nicholson, Director of the Museum, and a team of five lecturers the beautiful landscapes and rich cultural traditions of the Baltic and North Seas. During the longest days of the year, we will study, visit and enjoy the awesome fjords and other geological features, the abundant and exquisite birdlife, and the remarkable heritage of the Viking, Medieval and Renaissance periods. Following in the wake of early Norse sailors, we will cruise aboard the luxury ship, *Illiria*, to many of the most fascinating and remote ports in Scandinavia.

For further information please send the attached coupon or call (212) 873-1440.

American
Museum of
Natural
History

Discovery Tours

Central Park at 79 St.
New York, N.Y. 10024
(212) 873-1440

Please send me complete information on the Discovery Tour to Scandinavia, July 28 to August 15, 1983.

Name (please print)

Address

City State Zip 9/82

Which of these languages would you like to speak?

Mark the one you want to speak in 2 or 3 months' time

American English ☐
Arabic ☐
Chinese ☐
Danish ☐
Dutch ☐
French ☐
German ☐
Greek (Modern) ☐
Hebrew (Modern) ☐
Irish ☐
Italian ☐
Japanese ☐
Norwegian ☐
Polish ☐
Portuguese ☐
Russian ☐
Spanish ☐
Swedish ☐

A Linguaphone Course makes you feel at home in almost any country. You'll never miss the meaning of conversations or be at a loss for words.

- World famous over 4 million Linguaphone students in 88 countries speak a second language FLUENTLY.
- Proven learning success. You LISTEN to real conversations on casettes...UNDERSTAND what you hear by following illustrated textbooks... HOLD CONVERSATIONS with the speakers.
- Linguaphone Institute established nearly 60 years, a Division of Westinghouse Learning
- You learn faster and at less cost
- **Comprehensive - Basic and Intermediate Instruction ALL IN ONE COURSE.**
- You develop an authentic accent.
- **Money-Back Guarantee.** Linguaphone Courses are unconditionally guaranteed. Try it for four weeks. If you're not completely satisfied, return it for a full refund. There's no risk and no obligation, so order today!

Linguaphone The Language Masters

NO RISK GUARANTEE — 28 DAY FREE TRIAL

F.N.I., Inc. Dept. 109 313 Nolana Avenue McAllen, Texas 78501 (512) 687-4273

Please send me the complete course (comprehensive -- basic and intermediate). 30 lessons on cassettes and three books. $125.00 postpaid.

☐ Check enclosed. Charge my ☐ Visa ☐ Mastercard
Acct. # ________ Expires ________
Name (please print) ________
Street ________
City ________ State ________ Zip ________
Signature ________

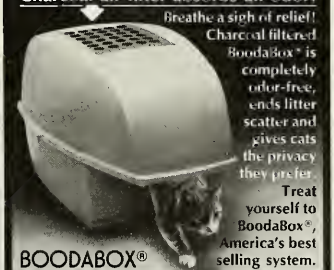
Enjoy the romance. . .
Send for a luxurious color catalogue of beautiful lingerie. French bra and bikini sets, lacy teddies, gowns, kimonos & much more.

Victoria's Secret designer lingerie

Send $3 to Victoria's Secret, Dept. NH-09
Box 31442, San Francisco, CA 94131
Boutiques in San Francisco, Palo Alto & Cupertino, CA

ODOR-FREE LITTER BOX

Charcoal air filter absorbs all odor!



Breathe a sigh of relief! Charcoal filtered BoodaBox® is completely odor-free, ends litter scatter and gives cats the privacy they prefer. Treat yourself to BoodaBox®, America's best selling system.

BOODABOX®

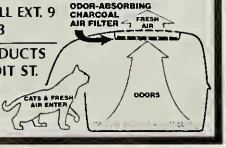
- Easy-off locking top cannot be dislodged by cats, dogs or children
- The canopied entry is 8"x14"
- King size litter pan is 8" deep
- Overall dimensions: 27"Lx16"Wx17"H
- Cream beige ABS plastic lets light pass into interior
- Charcoal filters last 6 mos. Replacements, $3.95 ea. (about 2¢ a day)
- Poly Pan Liners available
- Order forms provided with order.

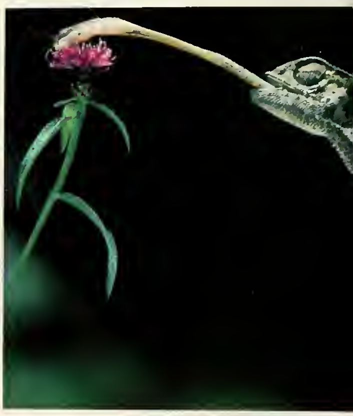
$34.95 + $4 Shipping.
Add $2.27 Tax in Calif.

UNCONDITIONAL 30 DAY MONEY BACK GUARANTEE

MC/VISA CALL EXT. 9
(213) 934-1093

BOODA PRODUCTS
439 S. DETROIT ST.
DEPT. NH-92
LOS ANGELES
CA 90036





Another insect is zapped by a chameleon tongue. Different lizard species use their tongues for a wide variety of purposes, including predator detection, sexual recognition, and the delineation of territorial boundaries.

Stephen Dalton, Oxford Scientific Films

avoid one another and to obtain food. Anatomical evidence supports the hypothesis that vomeronasal chemoreception is of greater importance for scincids than iguanids. The skinks' Jacobson's organs are well developed and may be aided by the slight bifurcation of the tip of the tongue. A long, thin bifurcated tongue is thought to deliver chemicals to the Jacobson's organs more efficiently than a thick, fleshy tongue.

The tongues of whiptails, which are extruded more often than those of the other lizards, are exceptionally long, thin, and forked, resembling those of snakes. The Jacobson's organs are well developed in these swift-moving terrestrial lizards. Visual communication among whiptails is not obvious and chemical communication may aid in social organization. These lizards do not seem to communicate with the head bobs, pushups, tail slashes, and other visual signs typical of iguanid lizards.

Other taxonomic families showed varying rates of tongue extrusions that also correlated nicely with the importance of vision and the development of the tongue and Jacobson's organs. Often, members of a single family show similar rates of tongue extrusions. This is not surprising since closely related species share similar evolutionary histories, resulting in many similar factors such as behavior and anat-

omy. But evolutionary divergences have also occurred within families, and members sometimes exhibit wide variations in the incidence of tongue flicking. For example, we compared field rates of tongue extrusions for Yarrow's spiny lizard with those of the Saint Vincent tree anole, which lives on Saint Vincent in the Caribbean. While Yarrow's spiny lizard extrudes the tongue an average of ten times per hour in the field, the Saint Vincent tree anoles almost never extrude their tongues. Both lizards are iguanids, but in this case they reflect some different evolutionary selection pressures. Although both are highly visual, the anole is arboreal while the spiny lizard is primarily terrestrial. One researcher has suggested that an arboreal form of life requires extremely sharp vision, resulting in massive orbital development; this, in turn, could leave less space for the olfactory and Jacobson's organs. Since these chemical senses are probably of less use in a nonterrestrial existence, presumably the net result was a displaced and reduced olfactory chamber. Although these speculations are untested, terrestrial lizards generally have much more developed olfactory chambers and Jacobson's organs than arboreal lizards.

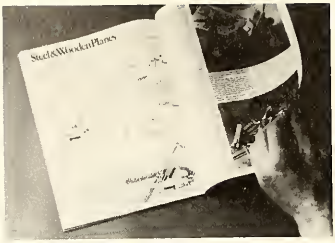
We have pieced together a great deal of interesting information about the lizard vomeronasal system, but much of it is speculative and a great deal of work remains to be done. Lizards are complex animals that rely upon a variety of sensory inputs. Even though a lizard may have excellent vision, it can rely upon other sensory modalities, such as chemoreception, to aid in various aspects of its life. Not all lizard species rely on tongue extrusion to the same degree. But for many lizards, tongue flicking serves a variety of useful ends, helping them make their way in the world. □

Pine Mallard Kit

Create handsome solid wood decorative ducks with easy-to-do kits. Each kit complete with fully carved and sanded head and body, glass eyes and detailed instructions. Stain or paint these beautifully carved Mallards (L-R) Drake and Hen, 12" long, $24.95 each or $45.00 a pair.

Send for 32 pg. color catalog of kits, finished waterfowl carvings, and 100's of decorating ideas. $1.00 or free with order.

Bay Country Woodcrafts
Dept. 668, Oak Hall, VA 23416



Turning into a better craftsman can be as simple as turning the pages of our new catalog.

Our new 244 page catalog is filled not just with pictures of great hand and power tools, but carefully written specs, detailed illustrations and recommendations from craftsmen who've spent much of their lives making, using and testing tools.

You'll know what they look and feel like, and you'll know how they fit your needs.

We believe you're not the average craftsman. So why should we give you an average catalog?

GARRETT WADE COMPANY
The Yankee Wood Craftsman

Garrett Wade Co., Dept. 94
161 Ave. of Americas, N.Y., N.Y 10013

Please send me your 244 page catalog of wood working tools, machinery and accessories. Enclosed $3.00.

Name________________
Address________________
City________________
State__________ Zip________

Sale! LAST TIME AT THIS PRICE!

Due to the soaring cost of GENUINE LEATHER, we cannot hold this price much longer. Order now.

The World's Most Comfortable Shoe!

Not ~~$50~~ Not ~~$25~~

Here Only **$14.88**

Genuine Leather
Smooth or Sueded

NOW! BLISSFUL COMFORT MORNING TO NIGHT! The closest thing to going barefoot! Handsomely-styled CosmoPedic shoes are the ultimate in comfort . . . and quality-crafted with features you'd expect to find in a **$50** or **$25** shoe! Luxurious genuine leather uppers in deer-tanned smooth or sueded leather are incredibly soft, yet amazingly shape-holding. The unique CosmoPedic arch support assures comfort thru long hours of standing or walking. A stitched collar prevents annoying chafing around the ankles. And for that walking-on-air feeling . . . comfort insoles and crepe soles pamper your feet from heel to toe! In Tan or Black smooth leather; Brown sueded leather . . . just **$14.88!**

TRY THEM AT OUR RISK! Return Within 14 Days for Money Back (except post. & hdlg.).

for Men and Women
Men's ½ sizes: 7 to 12, also 13
Width: C, D, E, EE, EEE
Women's ½ sizes: 5 to 10, also 11
Width: B, C, D, E, EE, EEE

Old Village Shop **Hanover, PA 17331**

SATISFACTION GUARANTEED OR MONEY BACK

OLD VILLAGE SHOP, Dept. VM-3B17, 340 Poplar Street, Hanover, PA 17331

Sure, I'll try the world's most comfortable shoes. Please send me:
___prs. Men's Tan Leather (M242578B) Size/Width____
___prs. Men's Black Leather (M236802B) Size/Width____
___prs. Men's Brown Sueded (M242586B) Size/Width____
___prs. Women's Tan Leather (M203562B) Size/Width____
___prs. Women's Black Leather (M203687B) Size/Width____
___prs. Women's Brown Sueded (M223784B) Size/Width____

for just **$14.88** pr., plus $2.90 per pr. postage and handling. **SAVE MORE!** Order Two pair for just $28.99 plus $5.00 postage and handling.

CHARGE IT: ☐ VISA ☐ Diners' Club ☐ Carte Blanche ☐ American Express ☐ MasterCard
☐ Enclosed is $________
Acct. #________ Exp. Date____
PRINT NAME____________
ADDRESS____________
CITY______ STATE_____ ZIP____

Our policy is to process all orders promptly. Credit card orders are processed upon credit approval. Delays notified promptly. Shipment guaranteed within 60 days.

© H.H.I. Inc., 1982

Celestial Events

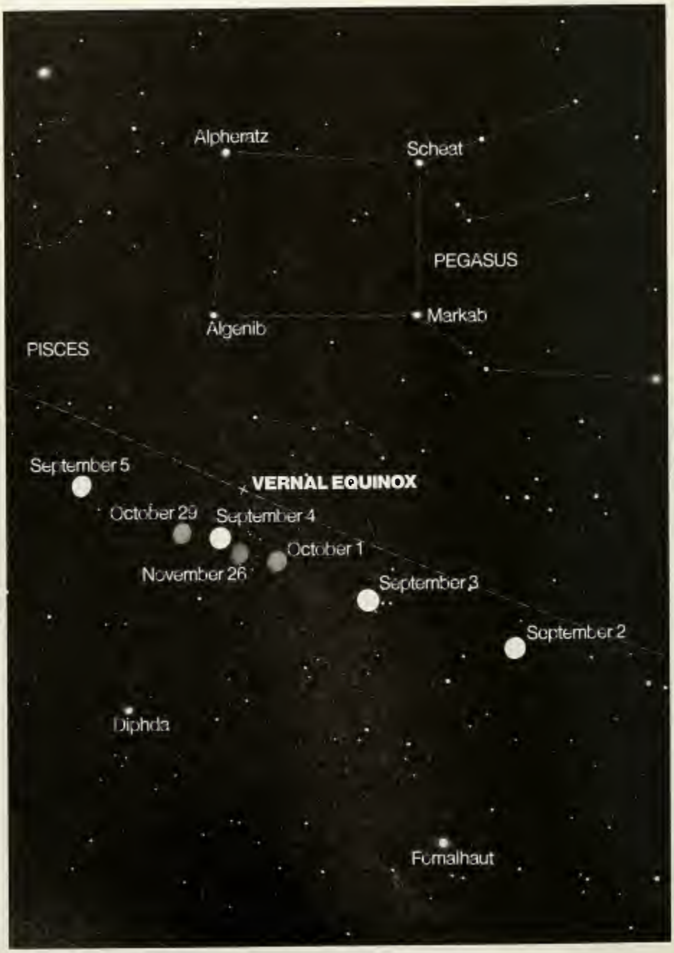
by Thomas D. Nicholson

All Month This is not a very good month for planets, but Jupiter is beautifully placed as an evening star, coming out of the twilight shortly after sunset. It is bright and easy to see until it gets too low shortly after dark. Mars isn't nearly as bright, but it becomes visible after dark well to the left of Jupiter. Watch it move swiftly through the stars from night to night toward Antares in Scorpius, nearly reaching that star by the end of the month. Saturn, to the right and below Jupiter near Spica (careful you don't confuse the star with Saturn), can be seen only on very clear nights low during the twilight hours for the first half of September. After that it sets too early. Venus is low in the east in the morning sky after dawn, but late in September it rises too late to be seen.

September 1: The waxing gibbous moon is in Aquarius, above the horizon at sunset, lighting the night well past midnight.

September 3: Full moon occurs in the early morning when it is below the western (right-hand) edge of the Square of Pegasus, with the stars Markab and Scheat above it and Fomalhaut (in the Southern Fish) below it. At night the moon moves below Pegasus.

September 4: Only a bit more than one day past full, the waning gibbous moon rises shortly after dark almost at the vernal equinox, in the constellation Pisces. Mark the moon's position relative to Alpheratz and Algenib, the two stars along the eastern (left-hand) edge of the Square, and you can easily remember from those stars where the vernal equinox is located. The sun is in that position among the stars each year on March 20 or 21 when spring begins in the Northern Hemisphere.



Helmut Wimmer

Since the sun is at the autumnal equinox in late September, the vernal equinox (opposite in the sky) and the region around it are features of the nighttime sky during the fall. The illustration shows where the vernal equinox is located relative to the four bright stars that mark the corners in the Square of Pegasus, and to the bright stars Fomalhaut and Diphda found to the south along the sides of the Square. The path of the moon through this region in early September is also shown, as well as the positions of the moon in October and November when it is nearest to the vernal equinox. This region of the sky rises in the east about sundown in September, but it is well up in the southeast or south at sundown later in the fall. Late at night it is found high in the sky to the south, as shown here.

September 6: Mercury is at its greatest distance to the left of the sun today (greatest easterly elongation). This ordinarily puts the planet in a good position as an evening star, but this is a poor elongation. Mercury is too low at sundown and sets too early to be seen, unless you are blessed with an exceptionally clear western horizon during evening twilight.

September 7: Venus may still be seen as a morning star, but very low in the east in late morning twilight. The star very close below it this morning is Regulus, in Leo. Venus passes from west to east (right to left) above Regulus about 4:00 A.M., EST.

September 9: One day before last-quarter, the moon is just above Aldebaran when it rises. The reddish star is in the V-shaped cluster called the Hyades, in Taurus. Moonrise is about 11:00 P.M.

September 10: Last-quarter moon, rising shortly before midnight between El Nath (above) and Zeta Tauri, the two second magnitude stars that represent the "horns" of the Bull.

September 13: The stars above and in line with the crescent moon early this morning are Pollux (the brighter) and Castor in Gemini.

September 14: Look in the dawn sky for Regulus, in Leo, just below the waning crescent moon.

September 17: New moon, in Virgo.

September 19: The young crescent moon should be visible in the east at dusk (weather permitting). Saturn and Spica are below it, both about the same brightness. Spica is the lower of the two. Jupiter, much brighter, is above and to the left of the moon. Mercury begins its retrograde (westerly) motion through the stars today as it heads in between the earth and the sun.

September 20: The crescent moon moves to the left above Jupiter at about 2:00 P.M., EST. After dark tonight, the easily recognized bright planet is below the moon.

September 20–21: To the right and below the moon, past Jupiter, you can see that Saturn moves from right to left past Spica from the evening of the 20th to the 21st. Remember last January when we told you about this year's triple conjunction of Saturn with Spica? That was when Saturn also moved to the left past Spica, but then it swung around in February and moved right on by Spica again going to the right (west). The last of these three events takes place shortly before midnight on September 20. You won't see Saturn pass Spica again for nearly 30 years, the time it takes the planet to move all the way around the sky.

September 21–22: The crescent moon passes Mars about 9:00 A.M., EST, on the 22nd. Watch it shift from right to left above the planet between the early evening of the 21st and the 22nd.

September 23: The sun is at the autumnal equinox at 3:46 A.M., EST, and autumn begins in the Northern Hemisphere. Since the sun is on the equatorial plane, it is supposed to rise due east and set due west exactly twelve hours later. Technically, it does this relative to the celestial coordinate system, the "imaginary" lines on the sky used to identify positions. But actually it doesn't do this because of the circumstances in which these observations are made on the earth.

September 24: First-quarter moon is in Sagittarius, above the "spout" of the imaginary "teapot" formed by its stars.

September 27: Twelve hours elapse from sunrise to sunset today according to the tables of rising and setting phenomena, because we measure from the upper edge of the sun and take refraction (by the atmosphere) into account.

September 30: Tonight's waxing gibbous moon is up at sundown, again midway between the Square of Pegasus and Fomalhaut, where it was on September 3. But, having gone completely around the earth in the past 27 days, the moon isn't full as it was last time it was here. Full moon doesn't occur for another three days.

Editor's Note: The Sky Map in the July issue shows the evening constellations and stars for this month and gives the times for use.

SOUTH AFRICA

**A world
in one country.**
Expect the unexpected. Abundant varieties of fauna, flora and peoples.
A rich land, unspoiled and beautiful.
For an unforgettable vacation experience, consult your travel agent or ask for your free color brochure, 'South Africa – Gateway to a Continent'.

South African
Tourist Corporation,
610 Fifth Avenue,
New York,
N.Y. 10020. NH-982
Tel. (212) 245-3720.
Telex 649535.
Name__________
Address__________

**Where summer is
four seasons long.**

satour

THE MARKET

Art

AMERICAN INDIAN CRAFTS: Southwest Indian pottery, baskets, rugs, kachinas. Northwest Coast Indian masks, totems, graphics, Eskimo sculpture. Recent African bronzes. No catalogue. One-of-a-kind pieces, individually photographed. Priced $100/up. Photos and data available. Specify interests. Box 5896, Sherman Oaks, CA 91413. (213) 789-2559

AUTHENTIC Cuna Indian mola patterns, 8" x 8". Cat or bird $4.00, both $6.00. Send check or money order to LaSala Ltd., Rt. 1, Box 214, Scottown, OH 45678

ESKIMO STONE CARVINGS, human and animal, $90 and up, request photos, McCoy Imports, Liberty, NY 12754

YOUR PET'S PORTRAIT, drawn from your own photo, or have your not-quite-perfect wildlife photo turned into a beautiful painting. Free brochure. Priced $20/up. Money-back guarantee. Animal Portraits by Mary DeLacey Lee, Box 7251, Paducah, KY 42001

Back Numbers

NATIONAL GEOGRAPHICS 1888-1982, issues Book Publications, Collectors Items, Send Wants Buxbaum Geographics, Box 465-NH, Wilmington, DE 19899

Books

BOOKFINDING LIBRARIANS locate any subject or title, 150,000 different titles in stock, indexed by author, subject & title. PAB, 2918 Atlantic Avenue, Atlantic City, NJ 08401 or (609) 344-1943

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalogue: Hamilton's, 98-55 Clapboard, Danbury, CT 06810

PUBLISHERS' OVERSTOCKS

All publishers — all subjects: art, history, biography, fiction, and much more. The most complete catalog of bargain books available anywhere! Write for your FREE copy:

Hamilton, 98-55 Clapboard, Danbury, CT 06810

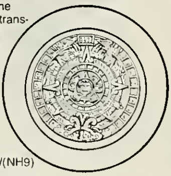
STEPHEN JAY GOULD REBUTTED! Tom Bethell rebuts Gould's "Darwin's Untimely Burial" (10/76) in Evolution, Extinction, and Catastrophism. Also, Norman Macbeth on Creation-Evolution. $6.00 postpaid Kronos, Box 343N, Wynnewood, PA 19096

TRAVEL, ADVENTURE, AND EXPLORATION BOOKS. The usual and the unusual. Free catalogue from The Armchair Explorer, Dept. NH, 333 Bellam Blvd., San Rafael, CA 94901

Collectors' Items

Pre-Columbian Collector's Plate

First issue: the historic sunstone AZTEC CALENDAR faithfully transformed from original in Mexico City's National Anthropological Museum! (See page 53 in 7/82 NATURAL HISTORY.) Fine white china 10" plate—2 gold bands encircle individually hand-tinted reproduction. **Signed!** $40 ppd. Check/VISA/MC.



BERNARDO
2400 Westheimer, Suite 108W(NH9)
Houston, TX 77098

Catalog of extensive collection of pre-Columbian rubbings! $2. *(deductible)*.

BIRDS ON POSTAGE STAMPS from many countries. 25 different 35¢ or 50 different 65¢ George Ford, P.O. Box 5203-N, Gulfport, FL 33737

Correspondence

INTERNATIONAL PEN FRIENDS—81,000 members worldwide, ages 10-89. Write: IPF, Box 65, Brooklyn, NY 11229

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin, West Germany

PENFRIENDS-ENGLAND-USA. Make lasting friendships through correspondence. Send age, interests. Free reply. Harmony, Box 89NH, Brooklyn, NY 11235

SCANDINAVIAN LADIES, sincere, seek correspondence for meaningful relationships. Details: Scannaclub, Dept. H6, Box 4, Pittsford, NY 14534

SINGLE BOOKLOVERS gets cultured persons acquainted. Nationwide. Established 1970. Write Box AE, Swarthmore, PA 19081 or call (215) 566-2132

Education

STARTING SEPT. 11, Workshop—New York Microscopical Society, "How To Use A Microscope". Registrar, Margaret Cubberly, Columbia Medical Center, 630 W. 168th Street, New York, NY 10032.

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest Handbook, $2.00 (guaranteed). Australian International, Box 19107-RW, Washington, DC 20036

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RW, Washington, DC 20036

OVERSEAS JOB—68 COUNTRIES! Hiring now! Paid fare. Computerized reports $2.00. Jobworld, Box 681-NH, Cypress, CA 90630

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . . Intermountain 4Y, 3506 Birch, Cheyenne, WY 82001

TEACH HERE—TEACH ABROAD: School, College openings; USA $5.95; Abroad $5.95. Placement sources: USA $4.95; Abroad $4.95. EISF, Box 662, Newton, Massachusetts 02162

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Israel. Sampler: 4/$2.98. Free Brochure. Multinewspapers, Box DE-209, Dana Point, California 92629

Gourmet Interests

15 EXQUISITELY, DIVINE gourmet recipes from world famous restaurants $2 SASE. "Gourmet Recipes", Box 240, Wausa, Nebraska 68786

Government Surplus

GOVERNMENT SURPLUS! Millions of items (Including Jeeps) . . . low as 1¢ on dollar! Most complete Directory available—$2.00. Disposal, Box 19107-RW, Washington, DC 20036

JEEPS, CARS, pickups from $35. Available at local Government Auctions. For Directory call (805) 687-6000 Extension 910. Call refundable.

Merchandise/Gifts

FREE, two all purpose greeting cards, spectacular floral prints, with set of 10 cards, envelopes, money back guarantee, send $5.95 plus .75 postage to Willow Branch Cards, 8223 N. Lake, Fox Point, WI 53127

GIFTS with a "natural" theme. Handcrafted jewelry in solid metals. Free Catalogue. CastArt, 2888 Bluff, Suite 338T, Boulder, Colorado 80301

GORILLA SKULL, lions, apes, human skulls. Museum quality reproductions. Inexpensive. Send for free catalogue. SKULLduggery, Box 1021-NH, Brea, CA 92621

HAWAIIAN GIFTS, Candy, Chimes, Lotions, Nuts, Tapa, Polynesian Art Reproductions. Catalogue—$1. Tropical Delight, Dept. 23, Box 5058, Hilo, HI 96720

NEW CLEAR PLASTIC BOOKMARK 8" x 2" with comparable weights and measures. Satisfaction guaranteed, $1.39 ea., 4 for $4.29. Postage Paid. PMC, P.O. Box 36539, Grosse Pointe, MI 48236

REPTILE PHOTOS, prints. Catalogue $2. HRA, 416 NW 94th St., Box 135S, Oklahoma City, OK 73114

Miscellaneous

IDEAS, INVENTIONS, new products wanted for presentation to industry. Call free 1-800-528-6050. In Arizona, 1-800-352-0458. X 831

1-800-334-8174 Puts you in contact with America's leading furniture mfg's at superlative savings. Barnes & Barnes, Library for Fine Furniture, 651 S.W. Broad St., Southern Pines, NC 28387. In NC call (919) 692-3381

"POETRY" of/from Hawaii. $5. Year's "Gourmet" fare. $14.95. Pi Press, Inc., Box 23371, Honolulu, Hawaii 96822

VIRGINIA CITY 1890 Map Folio (13 sheets) $16 ppd. Vl. Shkurkin, 6025 Rose Arbor, San Pablo, CA 94806 (415) 232-7742

Music

RECORDS-TAPES! Discounts to 73%. All labels; no purchase obligations; newsletter; discount dividend certificates. 100% guarantees. Free details. Discount Music Club, 650 Main Street, P.O. Box 2000, Dept. 25-0982, New Rochelle, NY 10801

Optical

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON, Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired. Large stock. Orders filled postpaid day received. Birding, Box 5N, Amsterdam, NY 12010

OPTIC DISCOUNTS: Binoculars—Telescopes—Brand Names—Free List. Thos. Manetta, Box 12, 61 Hoffman Ave., Elmont, NY 11003

Personals

MEET SINGLES Mexico, Orient, Europe, Australia. Free information. Write: International, Box 1716-NH, Chula Vista, CA 92012

Post Cards

NATURE POST CARDS—Close-up color photos of birds and animals. Beautiful & educational. $8.97 for 111, all different. Birds, Animals, plus all our other Nature Cards, 176 cards for $12.00. (Not retailed to Illinois addresses. Wholesale rates available all states.) Nature Press, 628 E. 20th St., Alton, IL 62002

Real Estate

FREE! BIG Fall-Holiday Catalogue! Over 5,400 country properties described, pictured! Land, farms, homes, businesses, recreation, retirement values! Selected best of hundreds of offices All Across America! Strout Realty, Inc., Executive Park Tower, Dept. 5390, Albany, NY 12203. Call toll free: 1-800-641-4266; in Missouri call collect (417) 862-4402

FREE CATALOGUE. Describes and pictures farms, ranches, acreages, businesses and town and country homes from coast to coast. United Farm Agency, Inc., 612-U W. 47th St., Kansas City, MO 64112. Call Toll-Free: 1-800-821-2599; MO res. call Toll-Free: 1-800-892-5785

GOVERNMENT LANDS. . FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00. Lands, Box 19107-RW, Washington, DC 20036

YEAR-ROUND RETREAT 1-hour NYC. High wooded setting, salt marsh/sound views. LR/Fpl., 4 BR, 2 B, K, D-L, Private Assoc. beach, tennis, mooring. $145,000. Call (203) 853-1897

Rental

FLORIDA, Manasota Key. Completely furnished house on the Gulf. Sundeck, screened porch, fireplace. Call (813) 877-1376

HAITI. Village near Jacmel, voodoo ambiance. Exotic villa sleeps five plus. Private swimming pool, infinite beach, tropical plantation, horses, four servants. $1,000 per week. Write for details: Oster, 241 W 11th St., NY, NY 10014

Resorts

JUNGLE VACATION in the Talamanca Rainforest. Superb birding, plant and insect hunting. Riding and hiking trails; guides. Weekly rates $225.00 single, $350 double. M.E. Snow, Apartado 73, 7200 Siquirres, Costa Rica

LITTLE ST. SIMONS ISLAND

One of Georgia's "Golden Isles"

Birding, beachcombing, riding, wildlife photography, fishing or just relaxing on a secluded 12,000 acre island with miles of unspoiled ocean beaches, forests and marshes. Over 200 species of birds. Maximum of 10-15 guests at a time. Excellent food and accommodations. Professional naturalists on the staff. P.O. Box 1078N, St. Simons Island, GA 31522 Phone (912) 638-7472

Tours/Trips

ADIRONDACK WILDERNESS SKI TOURS: Enjoy the exhilaration and beauty of a northern winter in the company of expert instructor/guides. Cross-country ski vacations are five days, limited to 10 guests, geared to all levels of ability. Daily excursions into "forever wild" Forest Preserve. Evenings spent in cozy lodge enjoying hearty meals, good company, and fireside programs featuring Adirondack naturalists, photographers and conservationists. Write: Adirondack Ski Tours, McMaster Rd., Saranac Lake, NY 12983 Call (212) 546-9202

AFRICA IS AFFORDABLE! 33 Fascinating Nature/Culture Programs, from under $2,000, all included. Forum Travel, 2437 Durant, Berkeley, California 94704 (415) 843-8294

ALASKAN WATER ADVENTURES. Kayaking, Rafting, Birding in Prince William Sound and Copper River Basin. College credit available. Open Door. Box 1185N, Cordova, Alaska 99574 (907) 424-7466

BAJA WHALE-WATCHING 5 days/4 nights, Scammons Lagoon whale-watching camp, Feb. 14-19, $774. Contact Wilderness: Alaska/Mexico, Dept NH, 5119½ 27th N.E., Seattle, WA 98105 (206) 522-5315

BECOME A SPARETIME TRAVEL AGENT, detailed guidebook explains how, commissions, travel benefits, $3.95 SAV Travel, Box 571-NH, Hicksville, NY 11802

DISCOVER BAJA! Join experienced naturalists and crew for leisurely ocean-going explorations of the wilderness islands and lagoons of Baja's Pacific coast, the Sea of Cortez, or Mexico's tropical west coast. Enjoy whales, seals, dolphin, birding, fishing, nature study, island hiking, and more! Excellent photo opportunities. Small groups, relaxed pace. Trips 4-10 days year-round for individuals or groups. Color brochure: Pacific Adventures Charter Service, 2445 Morena Blvd., Suite 200H, San Diego, CA 92110 (714) 275-4253

EAGLE/HAWK MIGRATION WORKSHOPS, Delaware River/Kittatinny Ridge flyways, 2 nights, meals, $110.00. Raccoon Ridge Bird Observatory, Box 126, Oak Ridge, NJ 07438 (201) 697-7233

GALAPAGOS ISLANDS, Costa Rica, The Amazon, Peru, New Zealand, Kenya and Tanzania. Fall/Winter departures with expert naturalist guides, small groups. Write: Wilderness Travel, 1760 Solano Avenue, Berkeley, CA 94707. (415) 524-5111

GALAPAGOS ISLANDS. Economic tours from $1666 including airfare. 4, 5, 8, & 15 days Galapagos, all meals. Options, mainland Ecuador, Amazon, Cuzco/Machu Picchu. University credit available. Joseph Colley, Last, Inc., 43 Millstone Rd., Randallstown, MD 21133. (301) 922-3116

Unusual India & Nepal

Trekking (walking) expeditions to the foot of Mt. Everest & Annapurna. Wildlife safaris in search of rare Asian birds and mammals. Explorations of remote Bhutan, Sikkim, Ladakh and tropical Sri Lanka. 10 to 35 day programs from $670.00 + airfare. Free Brochures.

Himalayan Travel, Inc.

P.O. Box 481-NH
Greenwich, CT 06830
(203) 622-0055 Toll Free (800) 243-5330

LEGENDARY CULTURES, FASCINATING NATURE. Special Travel to Latin America, Africa, Asia. Groups/Individuals. Forum Travel, 2437 Durant, Berkeley, California 94704 (415) 843-8294

NEPAL—TREKKING AND NATURAL HISTORY. Outstanding treks to Everest and Annapurna regions focusing on the culture and natural history of these beautiful areas. Expert leaders, small groups. Fall and spring departures. Write: Wilderness Travel, 1760-NT Solano Avenue, Berkeley, CA 94707 (415) 524-5111

NEW ZEALAND WALKABOUT. Escorted nature and hiking tours featuring New Zealand's scenic National Parks, plus the Milford Track. Pacific Exploration Co., Box 3042-N, Santa Barbara, California 93105 (805) 687-7282

POLAR BEAR photography trip to Churchill on Hudson's Bay, October 25. Gray whale cruises to breeding lagoons in Mexico. African wildlife photo safaris including gorillas in Rwanda. Detailed itineraries available. Adventures International, 4421-N Albert Street, Oakland, CA 94619

READY TO TRAVEL? Plan ahead with finest maps! $1.00 Catalogue. Eagle Eye, Box 751-N9, Paonia, CO 81428

THIS VACATION visit Africa's Ngoronogoro Crater. One hundred square miles of savage paradise and a sanctuary for the near extinct black rhinoceros. Write Civilized Adventure, 170 E. 88th, Apt 2G, NY, NY 10028 Phone (212) 860-0283. Departs Oct & Nov

200 YEAR OLD SPANISH RANCH. Unexcelled riding, great birding (200 species), wildlife. Delightful dining, sunshine, quiet. Adjacent to Kitt Peak Observatory, Papago Indian Reservation, Mexican border. Rancho de la Osa, Box 1, Sasabe, AZ 85633

RATES AND STYLE INFORMATION

The following new rates are effective with the January 1983 issue.

$2.00 per word, 16 word ($32) minimum. *Display classified* is $200 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY to: The Market, NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024. Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—1st of the month, two months prior to cover date (the January issue closes Nov. 1). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

American Museum of Natural History

DISCOVERY TOUR TO THE NILE

Discover the world of ancient and modern Egypt on an American Museum 600 mile Nile Cruise. Explore with three lecturers the rich natural and archeological sites of an area which has fascinated visitors for centuries...A carefully planned itinerary (with a special two-day program in London visiting the British Museum with its curator) provides a relaxing and thorough three-week Discovery Tour. All of the major Nile archeological sites as well as the important wildlife regions are discussed and visited with your balanced team of eminent lecturers. Share with Museum staff and friends an unforgettable cruise. February 6-26, 1983. For further information and itineraries write to the **American Museum of Natural History, Discovery Tours,** Central Park West at 79 St., NY NY 10024, or call (212) 873-1440.

American Museum of Natural History

Discovery Tours

Additional Reading

Baboons (p. 30)

S.A. Altmann and J. Altmann report on their research on the baboons of Amboseli National Park, Kenya, in *Baboon Ecology* (Chicago: University of Chicago Press, 1973), one of the most well-regarded and thorough studies of primate ecology available. The Altmanns focus on ecological material but also provide data on baboon populations, sleep sites and patterns, group movements, water and food, predators, and relationships with other animals. The article in this issue is derived from the work described by J. Altmann in *Baboon Mothers and Infants* (Cambridge: Harvard University Press, 1980), which is based on her long-term baboon research project in the Amboseli. The first report devoted to descriptions of baboon infants in a natural setting was written by I. Devore ("Mother–Infant Relations in Free-ranging Baboons," in *Maternal Behavior in Mammals*, edited by H.L. Rheingold, New York: John Wiley and Sons, 1963). Descriptions of other primate mothers and infants in Africa can be found in: "Mother–Offspring Relationships in Free-ranging Chimpanzees," by J. Goodall, in *Primate Ethology*, edited by D. Morris (Chicago: Aldine, 1967); "Development of the Mountain Gorilla (*Gorilla gorilla beringei*): The First Thirty-six Months," by D. Fossey, in *The Great Apes*, edited by D.A. Hamburg and E.R. McCown (Menlo Park: The Benjamin/Cummings Publication Co., for the Society for the Study of Human Evolution, Inc., 1979); and "Social Behaviour of Mother and Infant Vervet Monkeys (*Cercopithecus aethiops*)," by T.T. Struhsaker, in *Animal Behaviour*, vol. 19, pp. 233–50. For further reading on dominance hierarchies in baboons, see G. Hausfater's analytical monograph *Dominance and Reproduction in Baboons* (Basel: S. Karger, 1975). *Primate Societies*, by H. Kummer (Chicago: Aldine, 1971), is a short, readable, and informative introduction to primate group techniques of ecological adaptation that also includes a helpful annotated bibliography. *Primate Bio-Social Development*, edited by S. Chevalier-Skolnikoff and F.E. Poirier (New York: Garland Publishing, 1977), is a large-format, multiauthored volume containing both laboratory and field studies of a variety of primate species.

Bird Migrations (p. 40)

Migrant Birds in the Neotropics, edited by A. Keast and E.S. Morton (Washington, D.C.: Smithsonian Institution Press, 1980), brings together a selection of articles from a symposium held at the Smithsonian in 1977. This state-of-the-art book probes the problems of migrant temperate species wintering in the New World tropics, focusing on conservation, ecology, behavior, migration of taxonomic groups, regional studies, implications of overwintering in the tropics, and integrations. J. Dorst's classic work *The Migrations of Birds*, translated by C.D. Sherman with a foreword by R.T. Peterson (London: W.H. Heinemann, 1962), explores migrations in Europe, Northern Asia, North America, the Southern Hemisphere, and intertropical regions. It includes chapters on sea bird migrations, modes of migration, bird invasion, hibernation, physiological stimulus of migration, orientation of migratory birds, and the origin and evolution of migrations. E.O. Willis's "The Role of Migrant Birds at Swarms of Army Ants" (*Living Bird*, vol. 5, pp. 187–231) questions how migrant birds exploit food in areas, especially tropical ones, that already seem saturated with resident species. Willis studied birds that migrate from North America to Barro Colorado Island in the Panama Canal Zone to follow army ants, in spite of frequent supplantings and high competition for space among resident birds. He investigated the differing foraging behaviors of migrant and resident birds, the territoriality of migrants, their status, niches, habitat preferences, adaptations, and the effect that the destruction of tropical forests by humans is likely to have on the birds. Between 1968 and 1972, J.R. Karr visited a number of forests on several continents to study the organization of tropical forest avifaunas. In "On the Relative Abundance of Migrants From the North Temperate Zone in Tropical Habitats," (*Wilson Bulletin*, vol. 88, pp. 433–58), he examines his own work, capsulizes the published literature, and concludes that the evolutionary strategies of migrant birds are keyed to the exploitation of available resources in their tropical wintering areas. Within each of the three major geographical areas considered in the article, the number of migrants from the temperate zone fluctuates with vegetation type, elevation, food type, and season; additionally, there is variation between continents and adjacent islands and among the continents. "On Latitudinal Gradients in Avian Diversity," by E.J. Tramer (*Condor*, vol. 76, pp. 123–30), presents data on proportions of wintering North American birds in dry habitats in tropical Mexico. He constructs and analyzes latitudinal gradients in bird species diversity, scrutinizes diversity patterns using geographical scales, and investigates diversity gradients for both breeding and winter seasons.

Journey to Tibet (p. 48)

In China's Border Provinces, by S.B. Sutton (New York: Hastings House, 1974), is a biography of botanist-explorer Joseph Rock, beginning with his youth in Vienna and early work in Hawaii, where his interest in botany developed. In profiling Rock, his devotion to scientific research and exploration, and his involvement in political and economic issues in China, Sutton also re-creates a graphic cross-cultural portrait of China during a period of great change. "Seeking the Mountains of Mystery" (*National Geographic*, February 1930, pp. 131–85) is J.F. Rock's report on his three-year expedition, sponsored by the National Geographic Society, through the China-Tibet frontier to the unexplored range of the Amnyi Machen. In a fascinating article full of maps and illustrated with his photographs, Rock relates his experiences with Tibetan nomads, some of whom accompanied him on his trip, and depicts their land, religion, and customs, such as the Tibetan tea party. L. Clark's anecdotal narrative of his explorations in China and Tibet, *The Marching Wind* (New York: Funk and Wagnalls Co., 1954), is full of adventure and exoticism. Sample chapters are "Death in the Gomei Desert," "Snowbound," "Action at Fort Ta Ho Pa," and "Oring Nor's Ice Pack Breaks Up." Clark's very readable, firsthand chronicle includes valuable descriptions of the peoples and cultures he encountered and a lengthy account of his journey to Amne Machin Peak. More recently, P. Matthiessen and zoologist G.B. Schaller traveled through the mountains of Tibet and Nepal, seeking out the rare blue bharal sheep and hoping to sight the snow leopard. Matthiessen reconstructs his journey—which turns out to be not only a scientific expedition but also a spiritual one—in *The Snow Leopard* (New York: Viking Press, 1978).

Lizard Tongues (p. 58)

"The Gila Monster and Its Allies: The Relationships, Habits, and Behavior of the Lizards of the Family Helodermatidae," by C.M. Bogert and R. Martín del Campo (*Bulletin of the American Museum of Natural History*, vol. 109, pp. 1–238), contains chapters on classification and distribution of the beaded lizards; food and feeding habits; bodily functions, behavior, and activities; life history; ecology; the venom apparatus and its effect; bites inflicted on human beings; and man and the helodermatids. "Social Behavior in Hatchling Green Iguanas: Life at a Reptile Rookery," by G.M. Burghardt, H.W. Greene, and A.S. Rand (*Science*, vol. 195, pp. 689–91), explores the communal nesting areas and complex social interactions of hatchling green iguanas on Barro Colorado Island and an adjacent islet in the Panama Canal Zone. The authors' findings indicate the presence of sophisticated behavioral mechanisms and social organization in the iguanas and imply that a reevaluation of the evolutionary origins of vertebrate social behavior may be in order. L.T. Evans's "A Motion Picture Study of Maternal Behavior of the Lizard, *Eumeces obsoletus* Baird and Girard (*Copeia*, 1959, no. 2, pp. 103–110) analyzes a 16mm film taken during and after incubation. Evans outlines the female's care of her eggs, maternal care at hatching, and grooming of the offspring. "Iguanid Substrate Licking: A Response to Novel Situations in *Sceloporus jarrovi*," by A. De Fazio et al. (*Copeia*, 1977, no. 4, pp. 706–09), reports on the results of a study in which eight Yarrow's spiny lizards were exposed to three novel situations to compare their rates of substrate licking under these conditions with rates in their home cages. Because significantly more licking occurred in the novel situations, the authors propose that Yarrow's spiny lizard explores new situations mediated by its Jacobson's organ through substrate licking. B.A. Bissinger and C.A. Simon found substantial differences in baseline rates of tongue extrusions for families of captive lizards in "Comparison of Tongue Extrusions in Representatives of Six Families of Lizards" (*Journal of Herpetology*, vol. 13, pp. 133–39). They suggest that an increase in the frequency of tongue flicking is correlated with increased bifurcation of the tongue, and explore the possible uses of the extrusions.

Rita Campon

Erratum: The power plant shown in Ross Hudson's prize-winning photograph on page 26 of our July 1982 issue is a coal-fired, not a nuclear, facility.

THE EXTENDED VACATION
EGYPT
ALASKA
THE ORIENT & CHINA
MONEYSAVER TOURS · EUROPE

Have you traveled enough to be choosy"?

Then you're ready for one of these unusual Grand Circle Vacations

Grand Circle is different! We have Extended Tours that let you "live like a native" in the Alps, Paris, London, Italy, the Costa del Sol, or other locations. Countryside Tours to charming provincial areas. Top-of-the-line Selectours that lift your spirits to new heights. Romantic cruises to exotic ports of call. Money-Saver tours that are kind to your pocketbook.

We create these tours ourselves. That is why we give so many extras...personal attention from start to finish...congenial travelmates ..and direct-to-consumer prices that save you real money.

So this year, break out of your ordinary travel routine. Choose a Grand Circle vacation–for the travel experience of a lifetime!

Mail coupon now or
CALL TOLL FREE 1-800-847-4240
From Anywhere in U.S.A.–8:30 AM-5:30 PM EST
25 years of service to active, mature adults.

GRAND CIRCLE TRAVEL INC.
555 Madison Avenue, New York, N.Y. 10022

Yes, please send me free–and without obligation–travel brochures for programs checked:

FREE BROCHURES

- ☐ A. Europe Selectours & Moneysavers
- ☐ C. Countryside Tours of Europe
- ☐ D. East Africa Selectour
- ☐ E. Cruises–Incl. Around the World
- ☐ F. Egypt & India Selectours
- ☐ G. Extended Vacations in Europe, Middle East, No. Africa, U.S.A., Canada, Mexico & Caribbean
- ☐ N. Hawaii Selectours
- ☐ O. Orient Selectours & Moneysaver
- ☐ P. South Pacific Selectours
- ☐ Q. U.S.A. and Canada Selectours
- ☐ S. South America & Mexico Selectours & Moneysaver
- ☐ T. Alaska Selectours & Cruise
- ☐ U. China Selectours

W204

Name ______ (Please Print)

Address ______

City ______ State ______ Zip ______

In Elephant Country

by Boyce Rensberger

ELEPHANTS, by Reinhard Künkel. *Harry N. Abrams, Inc., $50.00; 225 pp., illus.*

If you have seen elephants only in a zoo or at the circus, you have probably never seen a real elephant, not a whole real elephant, anyway. For elephants, like any other animals, are more than flesh and blood. Elephants are also made of behaviors—behaviors that have evolved into forms at least as curious as trunks and tusks.

An elephant is a bawling baby squeezed under its mother's belly as a dozen older relatives surround the pair, facing out in defense against an approaching lion. An elephant is a frisky adolescent ripping up hundred-year-old trees and flinging them about. An elephant is 20,000 pounds sliding down a muddy bank, splashing into a river, and totally submerging itself until a fleshy snorkel breaks the waves for air. And an elephant is a lonely wanderer, happening upon the bones of a long-dead elephant and stopping for half an hour to trace the bleached forms gently with its trunk.

In captivity elephants can't really be themselves. That's why Reinhard Künkel's *Elephants* may be the next best thing

to a safari in Africa's elephant country. In 86 pages of text and 144 pages of color photographs, Künkel, a German wildlife photographer, celebrates the African elephant with a lavishness rarely devoted to a single species. Befitting its subject, the oversized book is itself a behemoth. It weighs nearly six pounds. The text is short but it is set in very large type on heavy paper. The 120 photographs are mostly run

Join us.

Trinidad/Tobago
February 12-26
South Florida
April 23-May 1
California
May 14-26
Alaska
June 5-24
Washington/British Columbia
August 27-September 10
Monhegan Island, Maine
September 7-11
Panama
Dec. 18, 1983-Jan. 2, 1984

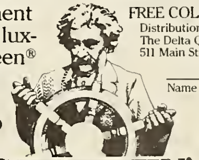
For details, please write:

JOSEPH VAN OS
NATURE TOURS
P.O. Box 655 • Vashon Island
Washington 98070

Delicate. Graceful. Elusive. STUDIES AND SKETCHES OF A BIRD PAINTER exhibits the rare genius of Raymond Ching in a magnificent oversized slipcased volume. Only $175.00—this is the epitome of

AN ABRAMS BOOK
110 E. 59 St., New York 10022

EVERY YEAR YOU WAIT, LONG AGO GETS FARTHER AWAY.
DELTA QUEEN



There's no time like the present to rediscover America's rich heritage. And the moment you step on board the luxurious Mississippi Queen® or the legendary Delta Queen®, you step back more than 100 years to the land our ancestors knew. Don't let long ago get away.

See your travel agent today.
Cruises From 2 to 12 Nights

FREE COLOR BROCHURES
Distribution Department, Box NH 21
The Delta Queen Steamboat Co.
511 Main Street, Cincinnati, Ohio 45202

Name
Address
City
State Zip
My travel agent is

STEAMBOATIN'©
MISSISSIPPI QUEEN • DELTA QUEEN

Treat yourself to our famous

Vermont Corncob Smoked Ham

at special introductory savings

. . . and we'll treat YOU to our Smoked Bacon and our Aged Cheddar **FREE!**

We smoke our Hams and Bacon over slow fires of corncob and maplewood, the way we've been doing it here in Vermont for over 100 years. The flavor is beyond compare — so much better than hickory smoked.

If you've never tried one, we'd like to send you a 6-lb. Cob-Smoked Ham (serves 6 to 8) at our one-to-a-customer Introductory Price of only $21.95 plus $3.00 postage and handling — a $33.25 value; you save over **$8.00.** Order now, and we'll ALSO include 12 oz. of our cob-smoked Bacon PLUS a half pound of our special Aged Cheddar — both FREE. Satisfaction guaranteed.

-----*HARRINGTON'S*-----

3009-2 Main St., Richmond, Vermont 05477

Send 6 lb. COB-SMOKED HALF HAM at special Introductory Price of only $21.95 plus $3 postage and handling. Include my FREE GIFT of smoked Bacon and Aged Cheddar. 7765

☐ Payment enclosed ☐ Charge my ( ) MasterCard ( )VISA ( )American Express ( )Diner's Club acct. (include card no. and exp. date). Offer expires Nov. 30, 1982.

Name ____________

Address ____________

____________ Zip ____________

Phone Orders: (802) 434-3411

Share the Thrills of Exploring Outer Space!

$359.95 f.o.b. Hartford, Conn.

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE — the same instruments used by more than 150 schools, colleges and observatories — and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

Criterion Manufacturing Co.
620 Oakwood Ave., W. Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION, MANUFACTURING CO., Dept. NH 118
620 Oakwood Avenue, W. Hartford, Conn. 06110
Please send your free Telescope Guide.

Name ____________

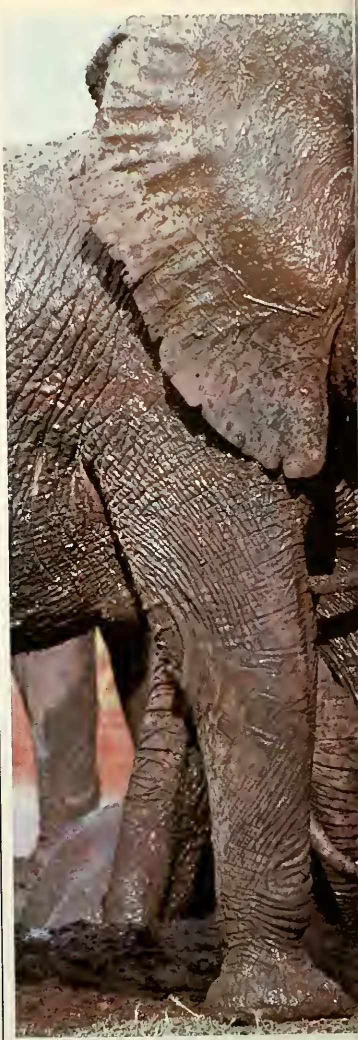
Address ____________

City ____________ State ____________

American Museum of Natural History
Discovery Tours

ARCHEOLOGY TOUR TO MEXICO Jan. 11 to 29, 1983
ANCIENT MAYA ARCHEOLOGY Jan. 31 to Feb. 17, 1983

Discover the ancient civilizations and archeology of pre-Columbian Mexico and the Maya world with the American Museum's C. Bruce Hunter. Sites on the Mexican tour include Mexico City, Cuicuilco, El Tajin, Jalápa, Cholula, Teotihuacan, Tula, Oaxaca, Mitla, Monte Alban, Cuernavaca, Xochicalco and Taxco. The Maya tour includes visits to Merida, Dzibilchaltun, Chichen Itza, Tulum, La Venta, Palenque, Edzna, Uxmal, Sayil, Xlapak and Labna. Tours include colonial towns, museums and the finest accommodations, and are limited to 18 participants. C. Bruce Hunter is Lecturer in Archeology at the American Museum, and author of A Guide to Ancient Mexican Ruins and a Guide to Ancient Maya Ruins. For further information write to DISCOVERY TOURS, American Museum of Natural History, Central Park West at 79 St., NY NY 10024, or call (212) 873-1440.



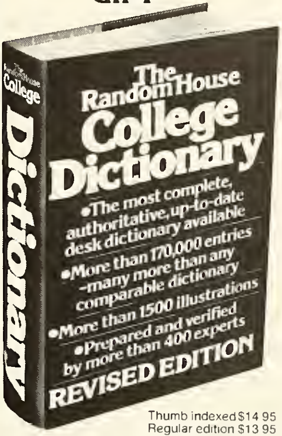
full or double page. Even the book's price tag is a hefty $50.

The first half of the book is text—a collection of Künkel's experiences watching elephants in East Africa, anecdote after episode of elephants being whole elephants—two bulls trunk wrestling in the shallows of a lake, a cow cleaning its trunk by reaming it on a tusk, another cow gingerly plucking ticks from its face with the fingerlike tips of its trunk. Trunks, those eight-foot-long combination noses, arms, and hands, are one of Künkel's great fascinations with the elephants. In the photographs, trunks figure prominently—scratching an ear, lifting a weak calf, coiled snakelike on a pair of tusks. Trunks

are good for more than scraping concrete for stray puffs of popcorn.

In the picture half of the book, Künkel's elephants are magnificent, stately beasts, lords of their domain. In only one photograph does Künkel permit us to see any sign that Africa is also a continent of people. A dead elephant, bespattered with vulture droppings, rots beside the fat, pink tissue that once filled the core of its tusk. The ivory is gone, hacked off by poachers. It is all too familiar an image to conservationists who have worried, almost helplessly, as the inflated price of ivory spurred the slaughter of elephants to unprecedented levels in the past few years.

In his text, Künkel makes more of the



THE *Smart* GIFT

The Random House College Dictionary
- The most complete, authoritative, up-to-date desk dictionary available
- More than 170,000 entries —many more than any comparable dictionary
- More than 1500 illustrations
- Prepared and verified by more than 400 experts

REVISED EDITION

Thumb indexed $14.95
Regular edition $13.95
Deluxe edition $15.95

Now at your bookstore RANDOM HOUSE

Publishers of *The Random House Dictionary of the English Language, Unabridged Edition*

Cotton Flannel Sheets & Natural Fiber Wearables

The Natural Fibers Catalog® now offers the widest and best-ever selection of wonderfully soft and warm things to sleep under or wear, including—

Our famous cotton flannel sheets and pillowcases in 12 solids, a stripe, a print and a check. **Wool and cotton blankets,** luxurious **comforters** filled with down.

In wool, cotton or silk: **long underwear** for men and women, delicate **lingerie from Switzerland and Italy,** beautifully fashioned **tights.** Plus—**sleepwear** of swiss cotton knit or flannel for men and women.

Children love our cloud-soft cotton or wool **long underwear, tights and socks,** cotton and flannel clothing, cotton turtlenecks, sweaters, plus wool hats, mittens and scarfs—and so much more, all of superb quality, all in the full-color pages of Garnet Hill's

The Natural Fibers Catalog®

garnet hill

6629 Main St., Franconia, N.H. 03580

$1 enclosed. Enter my 2-year subscription to The Natural Fibers Catalog® (beginning mid-September). Include flannel swatches with first issue.

Name ____

Address ____ Zip ____

Visit our shop in Franconia! Open Mon.-Sat.

Kăch-ĕl-ōfen.

Kachelofen. Fashioned by skilled artisans of masonry and ceramic tile, these stately, magnificent central heaters have warmed Alpine homes for 700 years. Housed in museums and castles throughout Europe, they are viewed as national treasures.

The WESO Ceramic Tile Stove from Germany is a direct descendant of Europe's mighty kachelofens. The WESO's cast-iron firechamber is surrounded by thick, hand-glazed ceramic tile which captures and releases the fire's warmth far better than metal could.

The WESO burns wood or coal and offers every efficiency feature you could ask for. Its beauty is breathtaking. Choose from 7 decorator tile colors, and enjoy the WESO's visible fire and all-over warmth. **We have stoves for immediate delivery.**

At last. An efficient woodstove beautiful enough for your home.

Rush me your literature portfolio by first class mail, featuring the WESO in all seven tile colors, complete performance data, details on WESO's new coal stove, and current shipping schedule. Enclosed is $1 to help cover mailing costs.

Name ____

Address ____

Zip ____

Ceramic Radiant Heat
603/524-9663

2929 Pleasant Drive
Lochmere, N.H. 03252

TRINIDAD RAIN FOREST

The ASA WRIGHT NATURE CENTRE offers the most convenient introduction to this rich tropical world of nature. Located on the northern mountain range, the Nature Centre provides a comfortable and attractive retreat.

- Rustic plantation setting
- Guides available
- Field trips
- Excellent photographic opportunities
- Five summer seminars

Write or call: **WONDER BIRD TOURS**, Dept. A10, 500 Fifth Avenue, New York, N.Y. 10036. Phone: 212/840-5961.

Brodrick's
Tool and Hobby catalog

A unique collection of quality tools for woodworking, home repairs and workshop. Special selections of hobby tools & kits, prepackaged hardwood and How-To books. From BRODHEAD-GARRETT, prime manufacturer/distributor since 1903. Limited copies. To reserve your FREE CATALOG, write or call

TOLL-FREE **800-321-6730**
(IN OHIO: 800-362-8915)
Brodrick's Dept. 118, 4560 East 71st St.
Cleveland, Ohio 44105

COLOR PHOTOGRAPHIC PRINTING

▼
CIBACHROME COLOR PRINTS OFFER PERMANENCE, BRILLIANCE AND FIDELITY TO YOUR ORIGINAL TRANSPARENCIES.

▼
At AZO LABS, we work closely with artists, museum directors and exhibition designers to produce the finest archival quality photographic printing, mounting and framing.

▼
Please call or write for our free museum package which lists services and prices.

AZO COLOR LABORATORIES, INC
149 Madison Avenue, New York, N Y 10016 (212) 982-6610

The Nautilus Candle
that lasts for years

Radiating a lovely warm glow, this 6½"-long candle burns down inside itself leaving the outer shell intact. Then, a votive candle can be inserted to make the Nautilus Candle last for years. $9.95 ea. (2 for $18.00). Add $1.00 postage/handling. Satisfaction guaranteed. MC/VISA/AmEx orders, include card no. and exp. date. Conn. res. add 7½% sales tax.
Send $1 for 36-page color catalog of fine gifts for the yachtsman (free with order).

MYSTIC SEAPORT MUSEUM STORES, Dept. 939 Mystic, CT 06355

great beasts' plight. He cites the grim statistics of Africa's dwindling elephant numbers—an estimated 1.3 million in 1979, being reduced by as many as 150,000 a year as the poaching continues and human numbers grow at the world's fastest birth rates. Künkel also recalls the bitter controversy that has split conservationists into opposing factions as human settlements push deeper into elephant country—whether it is better, through regulated killing, to reduce elephant numbers to a size that their shrinking habitats can support or to let nature take its course.

"And here they are," Künkel says, "the pachyderms, with their gigantic bodies and gigantic appetites, confronted by a world where only dwarfs have a slim chance of survival. The shooting programs instituted in many parks are a bitter reminder that true wilderness, in which nature can successfully maintain its own balance over seemingly infinite eons of time, no longer exists. Such programs reduce the parks to big open-air museums where a carefully computed number of elephants are allowed to display themselves as living curiosities."

Künkel's personal views are not well camouflaged. He calls human beings "dangerous and cruel neighbors" of the elephant and says people are the elephant's "most unnatural enemy," as if humanity somehow were not a part of nature. He condemns elephant "cropping" as a "clever euphemism." Yet Künkel is not entirely without hope. Recognizing that African countries lack the financial resources to conserve elephants in anything like their present numbers, he urges the conversion of Africa's national parks into international parks, supported by a worldwide network of sponsors. Künkel, however, does not develop the idea. Beyond mention of providing technical and administrative expertise, he says nothing of how to deal with the root causes of the elephant's decline—Africa's continuing population explosion and poverty. As long as more mouths must be fed, Africa will need more land for agriculture. As long as Africans remain desperately poor in the face of a spreading cash economy, people will continue to harvest the natural resource called ivory. Künkel's plea is unlikely to have much effect.

It may be unfair to criticize *Elephants* this way. The book, after all, devotes only a few of its pages to these matters. Its real purpose is to enthrall us with the spectacle, in words and pictures, of these huge creatures witnessed close up. Yet, in the text half, *Elephants* must be judged only a partial success. Readers who want a coherent, factual description of elephant biology and behavior will have to be satisfied with Künkel's offhand and sometimes anthropomorphic observations—he is not a trained wildlife biologist—and a few scattered references to the scientific work of Richard Laws and Iain Douglas-Hamilton.

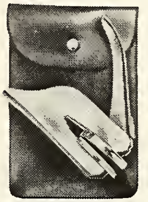
The photography works much better. Most of the pictures are stunning. Wild elephants are not easy to get close to, but Künkel has managed to capture images that bring the viewer within yards, sometimes only inches, of the great beasts. The book's large format helps; the largest pictures are the size of a newspaper page above the fold. Unfortunately, however, the quality of the printed color is not always up to the standard of the photography. Another annoying feature is the placement of the captions. They are all relegated to the back of the book, next to small black-and-white copies of the color plates, forcing readers to flip back and forth. Interestingly, some of the little black-and-white pictures succeed better as photographs than the color versions.

For all but the most avid collectors of coffee-table books, the book may not be worth the $50 price. Still, Reinhard Künkel's *Elephants* represents something to which no price can be attached. There is an undeniable fascination about living on the same planet with survivors from the vanished epoch of Pleistocene megafauna. The elephants really are one of our last touchstones with a lost evolutionary era. If you have seen elephants only in captivity and if you are not likely to get to Africa in the next few years, books such as this may be your best hope of sharing in the fascination.

Boyce Rensberger, a science writer who spent a year studying wildlife conservation problems in East Africa, is a senior editor of Science 82.

AVAILABLE BY MAIL ONLY
Sale! SAVE 25%

LIBRARY OF
RBM
ROBERT MILLER



The Mark of a True Book Lover

Thousands sold at $20 or more!

Now Only $14.95 EACH

Actual Size

This is the same heavy duty, chrome plated embosser used by librarians to mark and identify books.

Now you can have one with your own name and initials on a 1½" diameter seal. It's easy to use. . . insert the page, squeeze the handle and "LIBRARY OF (your name)" and initials will be clearly embossed (see photo).

This quality embosser is fully guaranteed and comes with a handy storage pouch.

Since this item has to be personalized, please allow 3 to 5 weeks for delivery.

How do you want your seal to read?

Print name and initials exactly the way you want them to appear

NAME ____ INITIALS ____

For additional embossers, simply print names and initials on a separate sheet of paper

Check One
☐ A check or money order is enclosed
☐ Please charge this purchase to:
☐ VISA ☐ American Express Card ☐ MasterCard

Account # ____ MasterCard ____ 4 digits above your name

Exp. Date ________ Signature ________

BARNES/SALE
& NOBLE/ANNEX
126 FIFTH AVENUE DEPT. E 413
NEW YORK, N.Y. 10011

Please send me______ embosser(s) at only $14.95 each plus $1.75 each for postage and insurance. (N.Y. and N.J. residents: Please add sales tax.)

Name ________
Address ________
City ________
State ________ Zip ________

Offer good only in the continental U.S.A 0038158
© 1982, Barnes & Noble Bookstores, Inc.

CHINA

EXPLORE THE HIDDEN CORNERS WITH SOCIETY EXPEDITIONS.

Only Society Expeditions offers in-depth cultural and archeological programs accompanied by expert lecturer/guides.

Stay in China's most luxurious accommodations in Beijing and Shanghai—State Guest Houses formerly used only for visiting dignitaries.

Follow the historic Burma Road into southwest China, and encounter people of remarkable ethnic diversity. Visit the Tibetan-influenced Wudang lamasery on the Yellow River's upper reaches. See the terra cotta army at Xian and the 51,000 statues of Datong's stone cave temples. Sleep in a yurt camp on Inner Mongolia's grasslands.

Venture beyond customary tourist routings to areas little-seen by Westerners. Very small groups. Very High Standards.

Society Expeditions

Dept. NH8209C 723 Broadway East, Seattle, WA 98102

Please forward your 24-page brochure.

Name ________
Street ________
City/State/Zip ________

The Audubon Society on the *entire* animal kingdom

The most comprehensive, entertaining, educational one-volume reference published on the animal world. Text by leading authorities. Illustrations by outstanding wildlife photographers. Over 1,000 photos (over half in color). 608 pages. 9" x 11".

The Audubon Society
ENCYCLOPEDIA
OF ANIMAL LIFE
Edited by John Farrand, Jr.
$45.00 now at your bookstore, or use coupon to order

Clarkson N. Potter, Inc.

CROWN PUBLISHERS, INC., Dept. 934
34 Engelhard Ave., Avenel, N.J. 07001

Please send me THE AUDUBON SOCIETY ENCYCLOPEDIA OF ANIMAL LIFE. Enclosed is my check or money order for $45.00 plus $2.00 postage and handling charge. If I wish, I may return book postpaid within 30 days for full refund.

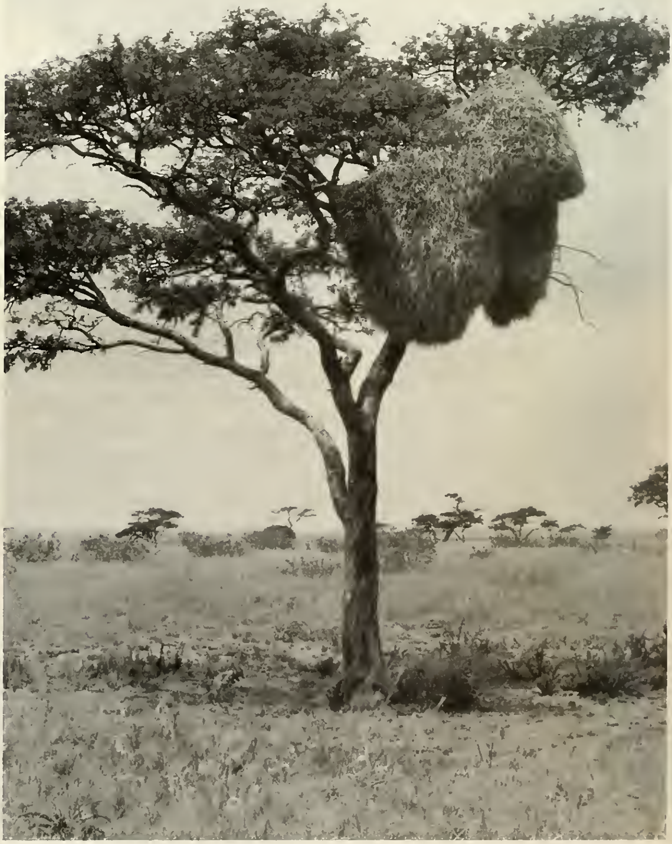
Name ________
Address ________
City ________ State ________ Zip ________
N.Y. and N.J. residents, add sales tax.

Nestworks

The American Museum of Natural History is known for having the largest and best collection of birds in the world. But some Museum ornithologists were also avid collectors of bird nests and the Museum has thousands of nests in its collections and vaults. (No one has an exact count since nests and eggs are cataloged together.) By far the strangest bird nest in the Museum is a social weaver bird's compound nest, which arrived from South Africa in 1925. At 300 to 400 cubic feet, it just might be the largest bird nest in any museum.

For more than half a century the display and upkeep of this mass of straw, twigs, and grass have taxed the ingenuity and expertise of the Museum's staff. The history of the nest began with James Chapin, a curator in the Bird Department, who was particularly interested in African bird nests. When a colleague of his at the Smithsonian Institution, Herbert Friedmann, was arranging a research trip to South Africa, Chapin pressed him to collect a nest of the social weaver, which he felt would greatly enhance the American Museum's collection. Friedmann accepted the challenge and set out for Africa in 1924.

The social weaver is a superlative bird architect, and flocks of birds build enormous "apartment house" nests in the flat-topped acacia trees of the South African veldt. Crafted out of coarse grass and twigs, the nests are not woven but thatched like a haycock. The result is a large, hanging mass of straw whose underside is perforated by the entrances to indi-



The Museum's huge weaver bird nest, photographed in South Africa in 1925 just before it was cut down for shipment to New York.

AMNH

Please send me information regarding the tours I have checked:

- ☐ **1983 General Program**
- ☐ **Archeology Tour to Mexico** January 11 to 29, 1983
- ☐ **Ancient Maya Archeology** January 31 to February 17, 1983
- ☐ **East African Safari** February 2 to 20, 1983
- ☐ **600 Mile Nile Cruise** February 6 to 26, 1983
- ☐ **Indian Ocean Adventure** January 21 to February 9, 1983
- ☐ **Indonesian Odyssey** February 3 to 24, 1983
- ☐ **Anthropology Tour to Morocco** March 26 to April 9, 1983
- ☐ **Art and Archeology Tour to China** June, 1983
- ☐ **Art and Archeology Tour to Tibet and Southern China** June, 1983
- ☐ **Alaskan Wildlife Adventure** June 24 to July 11, 1983
- ☐ **Cruise Through Scandinavia** July, 1983
- ☐ **Art and Archeology Tour to China** (The Silk Road) September, 1983
- ☐ **Anthropology and Ornithology Tour to Papua New Guinea** October, 1983
- ☐ **Ornithology Tour to East Africa and the Seychelles** October, 1983
- ☐ **Galapagos Islands Cruise with Highland Ecuador and Peru**

American
Museum of
Natural
History
iscovery Tours

entral Park West at 79 St.
ew York, NY 10024
212) 873-1440

NAME PLEASE PRINT

ADDRESS

CITY STATE ZIP 9.82

No Postage
Necessary
If Mailed
In The
United States

Business Reply Card
First Class Permit No. 2984 N.Y., N.Y.

postage will be paid by

American
Museum of
Natural
History

Discovery Tours

Central Park West at 79th Street
New York, New York 10024

Discover the World with the
AMERICAN MUSEUM OF NATURAL HISTORY IN 1983

You are invited to join renowned Museum experts on custom-designed cruises and land programs to the most fascinating destinations in the world.

Alaskan Wildlife Adventure
Cruise through Scandinavia
Archeology Tour to Mexico
Ancient Maya Archeology
Moroccan Anthropology
Nile Cruise
Art and Archeology Tours to China and Tibet
Galapagos Islands Cruise
East African Safaris
Indian Ocean Adventure
Indonesian Odyssey
Papua New Guinea Tour

INDIAN OCEAN ADVENTURE
January 21 to February 9, 1983

Visit India, Sri Lanka, Burma, Thailand, Malaysia and Singapore on a luxury cruise exclusively designed by the American Museum. Join Dr. Thomas D. Nicholson, Director of the Museum, and a Museum anthropologist, botanist, geologist, and ornithologist for a unique exploration of diverse cultures related by Hindu-Buddhism, and exotic natural habitats. Our luxury ship will be the "Illiria" which is exclusively chartered by the American Museum.

INDONESIAN ODYSSEY
February 3 to 24, 1983

Immediately following our Indian Ocean Adventure, the "Illiria" will sail from Singapore to Java, Lombok, Komodo, Flores, Butung, Sulawesi, and Bali. Share with a Museum anthropologist, geologist, botanist and naturalist an exciting voyage stopping at lush tropical islands with volcanic landscapes to visit fascinating local cultures. Both the Indian Ocean Adventure and this program may be combined for a six-week voyage throughout Southeast Asia.

NILE CRUISE
February 6 to 26, 1983

Explore the astounding ancient sites and natural wonders of Egypt with a Museum geologist, ornithologist and Egyptologist. Cruise 600 miles on the Nile from Cairo to Assuan aboard the custom-built, air-conditioned "Nile Star" stopping at all the important sites which have intrigued visitors for 4000 years.

CRUISE THROUGH SCANDINAVIA
July 28 to August 15, 1983

The Museum announces its first cruise through the North and Baltic Seas. Visits will be made to Bergen, Flamm, Gudvangen, Oslo, Copenhagen, Oland, Visby, Stora Karlso, Stockholm, Tallinn, Helsinki and Leningrad, in an extraordinarily comprehensive Scandinavian cruise. Join our expert lecturers on this rich cultural and natural history program aboard the luxury ship "Illiria."

GALAPAGOS ISLANDS CRUISE

Discover a special natural world with fantastically tame and exotic animals such as sea lions, giant tortoises, marine and land iguanas and countless rare and beautiful birds. Enjoy the expertise of a Museum ornithologist and geologist as we cruise through this equatorial archipelago which so influenced Darwin. Excursions in highland Ecuador are included in the tour, and an optional extension to Peru's archeological sites is scheduled.

LAND PROGRAMS

Ten outstanding overland itineraries have been custom-designed for small groups of 15 to 25 participants. China…Alaska…Tibet…Mexico…East Africa…Papua New Guinea…Famous and remote sites and cultures are discovered while staying at the finest accommodations available with distinguished Museum lecturers.

American
Museum of
Natural
History

Central Park West at 79th Street New York, N.Y. 10024

For further information concerning the Discovery Tours program mail **the attached card** to the Museum's travel office or call (212) 873-1440.

idual nests. Every year the flock adds to the nest, and sometimes the weight of the nest will cause the supporting branches to collapse. Nests have been observed in use over 100 years, and the very largest can reach almost 2,000 cubic feet in volume.

Friedmann's search for the perfect nest began in January 1925, near Maquassi, Transvaal. A railroad had recently been pushed through the area, and Friedmann scoured a swath of land five miles on each side of the tracks for 100 miles. The veldt was so flat and open and the nests so large that they could be spotted miles away. Friedmann claimed to have examined every nest in the 1,000-square-mile area—all twenty-six of them—before selecting a large, shapely, compact nest that looked as if it might travel well. The nest, some nine feet high, seven feet wide, and eight feet deep, hung in a twenty-five-foot acacia and covered about one-quarter of the tree.

Friedmann and his field associates decided that the nest couldn't be transported without the tree, so they trimmed off the excess branches, tied several guy lines to the crown, chopped through the trunk, and gently lowered the tree on to a horse-drawn cart.

Borrowing a technique used in collecting delicate dinosaur bones, Friedmann first covered the nest with burlap, then wrapped it with burlap soaked with plaster. This was followed by a layer of chicken wire and more layers of plaster. Friedmann, who was a great believer in the type of exhibit called the habitat group, or diorama, also collected some of the birds, made plaster casts of the acacia leaves, and even dug up a tubful of red earth near the base of the tree—all so that preparators back in the Museum could recreate the setting.

The chairman of the Bird Department, Frank M. Chapman, had authorized $100 in expenses for Friedmann to get the nest to port at Capetown. When the nest arrived in Capetown and Chapman was told that the shipping charge to New York would be £160 (a considerable sum at 1925 exchange rates), he was so horrified

AMNH

A social weaver

1982 Margaret Mead Film Festival

The 1982 Margaret Mead Film Festival will take place on four evenings, from Monday, October 4, to Thursday, October 7. Initiated by Margaret Mead six years ago, the festival is the largest and most important showing of anthropological films in the world.

Some themes of the 1982 Festival are *Dance and Performance*, *Fieldwork on Film*, *Ritual and Religion*, *Village Life*, *Art Traditions*, *Native Americans*, *Urban Life*, and a special series, *Films by Margaret Mead*. Sixty-six films will be shown, of which twenty-six are premières.

The theme *Looking at America* will be represented by such films as *The Life and Times of Rosie the Riveter* (about American working women in World War II), *The Gold Pit* (about two traders in New York City's gold futures market), and *Community of Praise* (about faith in a Christian Fundamentalist family). Another major theme, *Cultures in Transition*, will consist of films about the ways traditional cultures are adjusting to the modern world. Among the films in this category are *Three Horsemen*, by David and Judith MacDougall, about an Australian aboriginal family that resettles a cattle outstation; *Angels of War*, a powerful documentary about the impact of World War II on Papua New Guinea; and *Magic in the Sky*, about the arrival of television in an Inuit community.

All films and programs are free and open to the public. More information on the 1982 festival will appear in the October *Natural History*. The festival telephone number is (212) 873-1070.

Lecture Series

The 1982 series of lectures and field trips, sponsored by the Education Department, will begin in October. Some of the major lecture series this year are listed below:

Archeoastronomy of the Americas. The emerging science of archeoastronomy draws on both archeology and astronomy for an understanding of the astronomical belief systems and practices of ancient and contemporary native American peoples. This series of lectures, beginning on Wednesday evening, December 1, is given in conjunction with the special exhibition *Star Gods of the Ancient Americas*. The three lectures are *South American Archeoastronomy: Inca Astronomy and Nazca Ground Drawings*, by Anthony Aveni; *Astrology and Destiny among the Aztec and Maya*, by Susan Milbrath; and *Native American Portraits of the Sky*, by Von Del Chamberlain.

Two Lectures by Joseph Campbell. Joseph Campbell, famed writer and lecturer in the field of mythology, will lecture on two Wednesday evenings, October 27 and November 3. The first, *Myth and Body*, will look at the mysteries of birth, puberty, marriage, and death, and how they are related to myth and rite. The second lecture, *Symbolism of Indian Yoga*, will show the seven stages of psychological growth symbolized in the classic imagery of Indian yoga.

Other lecture series are *African Mammals*, *Identifying Minerals and Rocks*, *The Story of Gems*, *Animal Drawing*, *Explore Weaving*, *Ethnobotany of Native Americans*, *Natural Disasters*, *Plants of the Wetlands*, *Mammals of North America*, *and Magic*, *Witchcraft*, *and Sorcery*. Fees for the various series range from $12 to $35, with most costing about $30. Please call (212) 873-7507 for more information and a brochure.

People of the Xingu

Photographs of the people of the Xingu region of Brazil taken by filmmaker Maureen Bisilliat will be exhibited in the Museum's Center Gallery. The group depicted are the Mehinaku, who live in a small village in the Mato Grosso of central Brazil. The exhibit will remain on display until October 14.

Photo Contest Winners

The winning entries of the *1982 Natural History Photographic Competition*, which appeared in the July 1982 issue, are on display in the Akeley Gallery until October 14.

Audubon Films

Award-winning films selected by the Audubon Society will be shown at the Museum on Wednesday, September 8, and Wednesday, September 15, in the Auditorium. The films include *In Our Water*, an investigatory documentary based on a case study of chemical pollution in drinking water; *Secrets of an Alien World*, a close-up look at the world of insects; and *Lovins on the Soft Path*, in which the two Lovins, Amory and Hunter, present their global energy strategy, which advocates the use of soft energy such as wind, sun, and water. All the films are free.

that, according to people who worked with him, he wanted to instruct the shipping agents to dump the nest. But Chapin probably prevailed upon him to change his mind, and the nest was sent to the Museum.

The nest was put on display in the 1940s when the Sanford Hall of Biology of Birds opened. Chapin was in charge of erecting the exhibit, and after it opened, he would mingle with the crowds in front of the nest and listen to people praising it. (A story is told that one day, Chapin, finding a large and excited crowd in front of the exhibit, sidled up to hear the comments. To his dismay, he found that the people were watching the activities of a mouse that had made the nest its home.)

In the thirty-five years that the nest was on display, it began to deteriorate. Last year the Museum began renovating the Sanford Hall, and the weaver bird nest was given a thorough sprucing up. Dave Schwendeman in the Exhibition Department was assigned the task of cleaning, repairing, and "renovating" the nest. "The whole thing was filthy dirty," Schwendeman explained. "The paper leaves on the acacia tree had broken and fallen off, and some of the tree branches were also broken."

Schwendeman has had a great deal of experience fixing up birds and bird dioramas, but this nest posed an exceptional challenge. "First, we took off the limbs of the tree that were in our way," Schwendeman explained. "We swept up all the little leaflets from the acacia and saved them. Then we washed the nest with detergent and water, beginning at the top and flushing it through. The water ran out black at the bottom. We rinsed it with fresh water and blow-dried it with fans.

"To keep the straw in place we then sprayed it with a little Elmer's Glue-All, glycerine, and water—some 6 or 7 coats worth. Then, to restore the shine of new straw, we airbrushed the highlights with a little color. A final spraying with clear gloss varnish really perked it up.

"We made new leaves for the acacia tree, and reglued thousands of old leaves. All the weaver birds were taken out and cleaned individually.

"This isn't the first nest I renovated. I think we worked on the mangrove nests in the North American Hall in 1961 or '62, and the golden eagle nest. We're also rebuilding a collapsed osprey nest and some oropendula nests from the Sanford Hall. But as far as nests go, this weaver bird was the hardest. I'd say about three or four people worked full time on this thing for a month—just for one bird nest."

Douglas J. Preston

New York Zoological Society

The 1983 tour program offers natural history enthusiasts opportunities to explore wildlife ecology and conservation, both at home and abroad. Our carefully designed itineraries meet with our scientists in the field, and all are expertly led by Society naturalists.

MAJOR FOREIGN TOURS

FEBRUARY—EAST AFRICA
Kenya/Tanzania: Visit famous scientist Cynthia Moss in Amboseli where she does her field observations. Tanzania during the great migrations.

FEBRUARY-Baja
FEBRUARY-Costa Rica
MAY & AUGUST-Galapagos
JUNE-Zoos of Europe
JUNE-New Guinea & Australia
JULY-Kenya Only
SEPT.-Namibia
OCTOBER-China

NATURE VACATIONS

WEEKEND TRIPS
St. Catherine's Is.
Cape Cod/Whale Watch
Plymouth, Mass./Whale Watch
Cape May/Brigantine

DAY TRIPS
Hudson Sail
Hawk Mountain
Frogs & Toads

WRITE OR CALL (212) 220-5085
TO: TRAVEL, BOX 108, BRONX, NY 10460

NAME
ADDRESS
SPECIALLY INTERESTED IN

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: BOOKS-ON-FILE
Box 195 Dept. 72
UNION CITY, NEW JERSEY 07087

Wildlife Tours

Wildlife safaris Tanzania, Kenya, Botswana
Gorilla viewing Rwanda
Andes, Amazon and Galapagos islands
many other trips
Travel with the experts

Adventures International
4421-N Albert St., Oakland, CA
(415) 531-6564

Halls
Christmas Catalog
for Those With Impeccable Taste

Dedicated to those who have a flair for choosing just the right gift for everyone on their list—the Halls Christmas Catalog offers an unusual, exotic, and perfectly delightful selection of gift items. You'll find imports from Europe and the Orient, fashions and many items that are exclusively ours. Send for your Halls Christmas Catalog today.

Halls
A HALLMARK COMPANY

Please send me your 1982 Christmas Catalog...and future catalogs as they are published. I enclose a one-time postage and handling charge of $1.

Name
Address
City
State Zip
Phone #

HALLS CATALOG, Dept. 2055
505 Armour Rd., N. Kansas City, MO. 64116

Blue Notes

In Iowa, a company better known for appliances produces a blue cheese that rivals those from Europe

by Raymond Sokolov

In the normal course of things, babies begin life with a diet of mother's milk and, after weaning, move on to progressively more exotic foods and tastes. In the modern world, however, children often continue drinking milk right into adulthood. And the food industry provides them with a whole array of snacks, from bland burgers to sweet cookies. Even without the pressure of fast-food advertising and the extreme availability of such foods, children would probably show a preference for unchallenging tastes and familiar recipes. For children are, by their very nature, children, and sometimes they act it. Eventually, however, most of them grow up. Their palates mature too, and they learn to like food they once wouldn't have touched. These so-called acquired tastes mostly involve foods that have been cured or pickled or fermented, foods whose chemistry and taste have been altered by the action of microorganisms.

Blue cheese is a perfect example of such sophisticated food. Produced by a sort of controlled infection, it is literally moldy from the presence of *Penicillium roqueforti* or *P. glaucum*, blue-green cousins of the medically useful antibiotic molds of the same genus. A child may not know this, but he certainly understands that there is something "rotten" about Roquefort and Gorgonzola and Stilton and the other blue-veined cheeses. In my case, I was led beyond this negative first impression by parents who convinced me that eating such putrescent fare was an undebatable sign of maturity. I held my nose for the first bite but rapidly acquired a

Curds made from whole milk are scooped into stainless steel hoops for drainage and compaction.

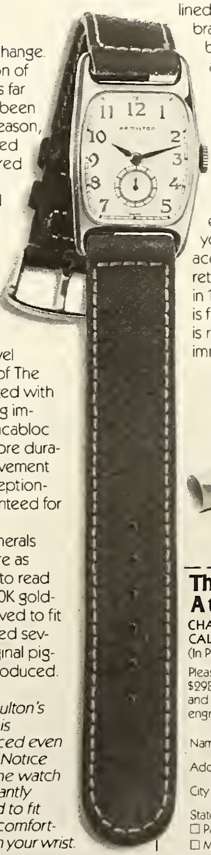
taste that has stayed with me long after I discarded other enthusiasms pushed on me by Mom and Dad.

Aside from helping to confirm my sense of superiority to other children, this yen for smelly, moldy cheese bred in me my earliest awareness that the American way of life did not nurture all things for which a discerning fellow might hunger. Imported cheese was obviously superior to domestic blue. You will understand the full extent of my commitment to this view when I tell you I formed it at age twelve,

Photographs by Adelaide de Menil

Hamilton's classic timepiece of the Thirties

The Boulton: available once again in a strictly limited edition, reproduced from the original dies and tooling.



In the Thirties, fine design and fine timepieces were a matter of personal pride—and Hamilton was a standard of excellence. Hamilton's Boulton watch was an instant success, eagerly sought and much admired.

A classic in 1934, reborn in 1982.

Some things never change. Indeed, the appreciation of fine classic timepieces is far higher today than it has been in many years. For this reason, Hamilton has reintroduced The Boulton, manufactured from the carefully preserved original dies and tooling, in a limited and registered edition for those who appreciate the beauty and value of a true classic.

A precision 17-jewel movement.

The precision 17-jewel mechanical movement of The Boulton has been updated with two recent watchmaking improvements: superior Incabloc shockproofing and a more durable mainspring. The movement of this fine watch is exceptionally accurate, and guaranteed for two full years.

The gold-plated numerals and solid brass hands are as cleanly styled and easy to read as on the original. The 10K gold-filled case, uniquely curved to fit the wrist, is hand-polished several times. Even the original pigskin strap has been reproduced.

The Boulton's styling is advanced even today. Notice how the watch is elegantly curved to fit more comfortably on your wrist.

A strictly limited edition.

Only 2,032 of these fine timepieces have been made available in a strictly limited, registered edition. Of these, well over half have been purchased. After the remainder is acquired, the dies for The Boulton will be donated to the National Association of Watch & Clock Collectors in Columbia, Pennsylvania, and this classic Boulton watch will never again be available.

Hamilton's Boulton watch is $298, with tax, shipping and handling included. Each Boulton has been carefully packaged in a solid cherry presentation case, richly lined in plush burgundy velvet. A solid brass nameplate on the case will be engraved with three initials at no charge. An accompanying Certificate of Authenticity from Hamilton will bear the registered number of your watch, matched to an engraved number on the underside of the case.

The Hamilton Guarantee.

No effort has been spared to ensure that The Boulton will please you with its classic appearance and accuracy. If not delighted, you may return it, in condition received, within 15 days for a full refund. If the edition is fully subscribed when your order is received, you will be notified immediately for a prompt refund.

The Hamilton Watch Company
A tradition since 1892.

CHARGE YOUR ORDER:
CALL TOLL FREE 800-233-0281 EXT. 175
(In Pennsylvania call 717-394-7161 Ext. 175)

Please send my Boulton watch. I understand that the $298 price includes tax, shipping and handling. Three initials to be engraved on presentation case: ☐☐☐

Name ____________
Address ____________
City ____________
State ____________ Zip ____________
☐ Payment enclosed ☐ Charge my:
☐ MasterCard ☐ VISA ☐ American Express
Acct. # ____________
Interbank # (MC only) ____________
Exp. Date ____________
Signature ____________

The Hamilton Watch Company
Collector's Classic Edition Society Division,
P.O. Box 7343, Dept. 263, 941 Wheatland Ave.
Lancaster PA 17601

298

CRUISE TO THE WORLD'S HIDDEN CORNERS.

Visit penguin rookeries in Antarctica and isolated tribal villages in New Guinea. See the monuments of Burma and Sri Lanka and the ritual dances of Indonesia. Study the profusion of birds in the Seychelles and the exotic marine life of the Great Barrier Reef.

Learn from our accompanying lecturers and expert guides.

Our 120-passenger WORLD DISCOVERER is unique, with a combination of expedition capabilities, special landing-craft, and traditional cruise amenities.

Society Expeditions
CRUISES
Dept. NH8209W 723 Broadway East, Seattle, WA 98102

I want to know more about Society Expeditions cruising programs. Please send me your 48-page catalog

Name

Street

City/State/Zip

M.S. World Discoverer Registered in Singapore

ZUNI

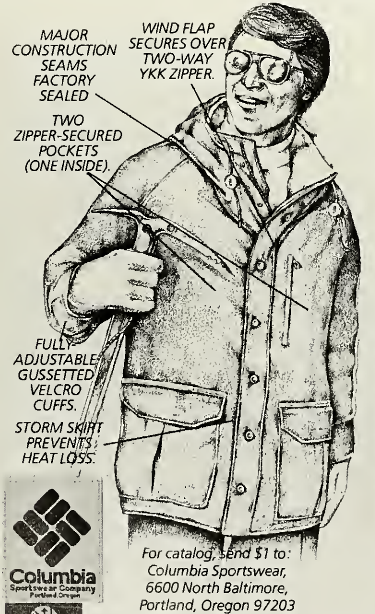
HANDCRAFTED INDIAN JEWELRY

The jewelry of the Zuni Craftsmen represents hundreds of years of spirit and tradition. Choose a piece of this history from their exquisite 16 page color catalogue.

Mail $2.00 for postage & handling to:
Zuni Craftsman Cooperative Dept. NH
P.O. Box 426, Zuni, New Mexico 87327
$2.00 will be deducted from your first order.

Name
Address
City
State Zip

Item: The Trinity Alps


MAJOR CONSTRUCTION SEAMS FACTORY SEALED
WIND FLAP SECURES OVER TWO-WAY YKK ZIPPER.
TWO ZIPPER-SECURED POCKETS (ONE INSIDE).
FULLY ADJUSTABLE GUSSETTED VELCRO CUFFS.
STORM SKIRT PREVENTS HEAT LOSS.

DESCRIPTION: Gore-Tex™ Thinsulate® Foul-Weather Parka.

SPECS:

Fabric: Gore-Tex™ laminated to Exacta™ Cloth.
Inside: Gore-Tex™ lets perspiration escape, but completely blocks rain, mist, etc.
Outside: Durable, snag-proof Exacta™ Cloth for long wear.
Insulation: Thinsulate® (200 gms./sq. meter). Extends to full length and hood. Factory-sealed major construction seams eliminate leakage.
Lining: Nylon taffeta.
Pockets: Total—6, 2 zipper-secured upper pockets, 2 Velcro-secured lower cargo pockets with "bellows" pleats for extra capacity, and 2 hidden Thinsulate® lined hand-warming pockets.
Hood: Permanent full cut for wear over headgear or alone. Draw-string provides weather seal. Soft visor shields glasses/goggles from rain.
Gen. Notes: Men's S to XXXL. Women's XS to L. Made in Portland, Oregon.

Thinsulate ZEPEL

For catalog, send $1 to:
Columbia Sportswear,
6600 North Baltimore,
Portland, Oregon 97203

Columbia Sportswear Company Portland Oregon

GORE-TEX FABRIC

We don't just design it. We engineer it.

Thinsulate® is a registered trademark of 3M. Gore-Tex™ is a trademark of S. L. Gore & Assoc., Inc.

on a brief foray into town from a summer camp in Wisconsin, the mecca of American cheese manufacture. Supermarket blue, neatly wrapped in foil and sold in tiny wedges, did not compare to the creamier, smellier, one- and two-kilo Danish wheels we bought at a specialty store back home in Detroit.

Some thirty years later, the itinerant turophile can find properly merchandised blues from virtually every country in Europe in dozens of competent cheese stores across the land. It would not surprise me if I could now effect the purchase of a Christmas Stilton or even the Finnish blue called JalØ-Juusto in my former summer haunt, Minocqua, Wisconsin.

But in a time when the least patriotic among us has cause to wish that he could find a way to buy American products without utterly compromising his self-interest, the news that small cheese factories on a European model have begun to turn out very successful versions of classic cheese is welcome news indeed. Entirely apart from one's relatively abstract interest in the beneficial pressure this will apply to our balance of payments, domestic cheeses tend to cost less. And, while I am grudgingly ready to pay $9 a pound for a simple farmhouse goat cheese from France, I would rather pay half that sum to a compatriot.

It is notions like that which, if taken seriously, persuade you to fly to Des Moines. Only a short drive east of the state capital, on Interstate 80, the dairy farms begin. Big, dumb, black-and-white Holstein cows with udders swollen like bagpipes graze on the gently rolling meadows on either side of the road. And a short detour north on Iowa Highway 14, just west of Newton, leads to a paragon of a traditional Iowa dairy farm, complete with classic, plain white clapboard farmhouse and cow barns.

They make blue cheese at that farm. It is as good as any I have ever tasted, and if I had known about it in 1953, I could have appeased my hunger for blue cheese by ordering a wheel through the mail. In fact, the first batch of this splendid Iowan cheese came out of the curing cave in 1941, the year I was born. It all had to do with washing machines.

The late E. H. Maytag inherited the family appliance company from his father, F. L. Maytag, who had founded the concern. During the 1920s, E. H. dabbled in Holstein-Friesians on a spread just north of the Newton plant. He built up a prize herd, which in 1940 passed to his son, Fred, along with the company. Fred took the dairy operation one step further. He incorporated it and set up a cheese-making business to exploit all that Holstein-Friesian milk.

As it happened, a Danish dairy scientist, then a professor at Iowa State University at Ames down the road a piece, had just patented a process for making blue cheese. Fred Maytag acquired the rights to the process and used it for the "cottage" cheese industry that still flourishes without mechanization in the shadow of the nearby Maytag appliance assembly plant.

Now, the Maytag Dairy Farms have to bring in milk from non-Maytag cows to meet the cheese production schedule of roughly 250,000 pounds of blue a year. That is only a drop in the pail compared with overall American blue cheese production, about one percent of the total. And you aren't likely to see the blue-and-silver Maytag logo with its Holstein silhouette in your local supermarket because three-quarters of the cheese is sold through the mail and most of the rest in Iowa outlets. That way, Maytag can control quality, keeping production down to a manageable size and making sure that only cheese that is ripe gets to consumers.

The cheese production area is open to the public. It is impressive because it is completely unencumbered by large automated vats and stirrers and plumbing to draw off whey—the kind of space-age equipment prevalent in mass-production cheese factories.

The process is classic. Whole milk is coagulated into curd, hand stirred, and then dosed with a blue-green powder. This powder may come from a manufacturer in Waukesha, Wisconsin, but it is the primordial substance for making blue cheese blue. According to legend, the first blue was produced by accident: a shepherd was eating white cheese and dark bread when a storm struck. The shepherd stashed his sandwich under a rock and ran for shelter. Some weeks later he found that mold from the bread had invaded the cheese, rendering it blue, creamy, and tangy.

In Wisconsin, and in Europe, they culture moist bread with penicillin and then grind it all to powder. At Maytag, they then incorporate the powder into the cheese and, so that air can penetrate the cheese and encourage mold growth, they perforate the cheese with a special hand device fitted with long metal needles.

About one thousand pounds of this "green" cheese goes into the curing cave each day. Mold grows from the center out and in three to four weeks covers the outside of the wheel. That mold gets washed off with a nylon brush. The cheese is dried, dipped in wax, and refrigerated for six months of aging, at least twice the normal time in conventional cheese production.

There is not much difference between Maytag blue and other cheeses cured with internal mold. But there are small differences, and they give Stilton and Roquefort and the other blues their individual character. Roquefort, for example, is made entirely from the milk of ewes. And it must be cured in the natural caves of Roquefort-sur-Soulzon, a village of the Aveyron where the plentifully circulating cool air and high humidity perfectly promote the growth of mold and have done so since at least 1407, when Charles VI gave the people of Roquefort letters patent, granting them alone the right to use their "breathing mountain" for curing cheese.

In more modern times, by law in 1925, and by the International Convention of Stresa in 1951, the trade name of Roquefort has been protected and defined. Roquefort is rather heavily salted and, like Maytag blue, Gorgonzola, and many other blues, it has the mold scraped off its outer surface and then is covered in foil to impede further exterior molding during the aging phase.

Cheeses with internal mold that are not made from ewe's milk are the true blues. The nouvelle cuisine has fastened on one of them, a blue cheese of the Auvergne

Why this new kind of fireplace-stove makes ordinary inserts obsolete

You've seen them all — the tube grates, glass doors and fancy andirons that seem to promise much but deliver only modest fireplace heat savings. You've looked at sheet-metal inserts, one uglier than the next. And you wonder why on earth hasn't someone come up with a truly efficient fireplace heat reclaimer that you'd really like to live with?

Finally, someone has. The Shelburne Fireplace-Stove can transform your fireplace from a heat *waster* into an incredibly efficient heat *producer* — without compromising the visual and soul-warming pleasures it provides.

Initial tests in the calorimeter room of an independent research lab produced a plus-50% percentage efficiency rating, dramatically higher than ordinary non-airtight inserts, very close to that of the best woodstoves. But the Shelburne *enhances* rather than hides your fireplace, complements rather than insults your room decor.

Stretch out and relax before the fire, flickering behind safe Corning Pyroceram glass. The extraordinary flame pattern you see is proof of the Shelburne's amazing efficiency, as its downdraft preheated-air system creates a vortex of burning wood gases.

Efficiency on wheels

The Shelburne fits snugly into your fireplace yet *rolls out easily* on concealed wheels for chimney inspection and cleaning. A thin blanket of space-capsule insulation and extensive baffling minimize heat loss up your chimney, while its quiet fan delivers gentle convection warmth for hours to your rooms.

The Shelburne is totally in a class by itself. Let us prove it to you, with color photos and complete details. Please use the coupon below.

The Shelburne Fireplace-Stove

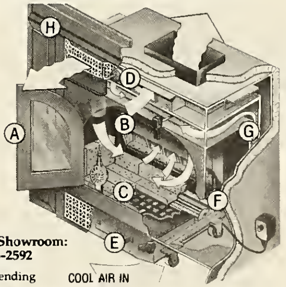
Rush me your Information Portfolio including full details on the Shelburne Fireplace-Stove. Enclosed is $1 to help cover mailing costs.

Name______________________

Address____________________

______________________ Zip ________

The Vermont Stove Company
Dept. 2429, Rte. 7, Shelburne, VT 05482
802-985-2592



Factory Showroom:
(802) 985-2592

Patents pending

© 1982 Vermont Stove Co., Inc

(A) Doors may be opened to view the fire (B) Air is preheated as it enters downdraft and secondary air tubes (C) Firebrick-lined ¼" steel firebox (D) Automatic thermostat (E) Pull-out ash pan (F) Fan with speed control (G) 40" baffling system **(H) Flanges in choice of 3 widths permit installation in over 80% of all fireplaces.**

"Green" wheels of blue cheese are inspected before being aged in cellars for six months. The wheels are perforated to allow air penetration, encouraging mold growth.

highlands called fourme d'Ambert. *Fourme* is patois for "cheese," deriving from the Latin *forma* ("form"), which is also the ancestor of *fromage*. Part of the appeal of fourme d'Ambert must arise from its folkloric past, when it was put in hollow rocks to ripen. These days it is still coagulated in peasant huts, and the outer mold is not scraped off but allowed to harden. Because the curds are not pressed, fourme d'Ambert has a fine blue marbling and it is more granular than other blues. Its taste might be described as lightly astringent.

Stilton is the other major blue that is allowed to develop a hard, moldy exterior. Gorgonzola, encrusted in legends dating as far back as A.D. 1000, is produced with refinements of temperature and handling that are too complex to describe. Even the treatment of the fresh milk is intricate. By tradition, the cheese comes from two batches, the evening milking and the morning milking. The evening batch is coagulated while still warm from the udder and allowed to cool overnight in canvas bags, draining as it cools. The morning batch is also coagulated warm, but it is not cooled, and it drains in wood forms. The two batches are assembled together in molds with the evening curds placed in the center. The cheeses are eventually pierced with needles, but no penicillin is added. Evidently, mold is present in the air of the curing caves.

All of these blue cheeses, whatever the particularities of their production, should be eaten as quickly as possible after they are opened. If you buy a wheel, you have the advantage of knowing you are the first to open it. It also helps if you can be sure that the cheese itself has been properly stored and comes to you at the optimum time in its life, before it gets crumbly and tastes like ammonia. This is the need that Maytag tried to answer in the days before sophisticated cheesemongers and expensive airborne routes of importation had combined to present him with serious competition.

Raymond Sokolov's new book, Fading Feast *(Farrar, Straus and Giroux) is a collection of food columns that first appeared in* Natural History.

Blue Cheese and Walnut Hors d'oeuvre

(Adapted from a recipe by Roger Vergé,
in *Ma Cuisine du soleil*,
Robert Laffont, Paris)

- 1 ounce (2 tablespoons) unsalted butter
- ¼ pound shelled walnuts, roughly chopped
- ½ pound blue cheese
- 2 tablespoons cognac
- Freshly ground black pepper
- Stale French bread
- Hearts of celery
- Radishes

1. In a bowl, let butter soften and then work it with a wooden spoon. Add the chopped walnuts and mix them until they are coated with butter.
2. Mash the cheese with a fork and add to the nut mixture. Then add the cognac and a small amount of pepper, four or five turns of the pepper mill. Mix well.
3. Toast the bread, spread with cheese-nut mixture while still hot, and serve immediately. Raw celery and radishes should be passed separately. The traditional presentation of this dish, in southern Provence, involves French loaves cut lengthwise in long *tartines*, which are toasted under the broiler. Served with soup, they constituted the evening meal.

Yield: Four servings

Pastourelle

(a salad of the Aveyron)

- 2 ounces (about 3–4 tablespoons) Roquefort or other blue cheese
- ½ cup creme fraiche
- 1 tablespoon vinegar or lemon juice
- Salt
- Pepper
- Fresh chervil, finely chopped
- Fresh tarragon, finely chopped
- 4 heads bibb lettuce or 1 head romaine, thinly sliced
- Dark bread

1. Mash the cheese in a bowl. Work the creme fraiche into it gradually.
2. Mixing constantly, mix in the other ingredients.
3. Serve with the bread.

Yield: Four servings

Volkswagen introduces luxury widebodies.

All seats first class.

With all the juicy enticements the airlines have used to get more people traveling their way, we thought we'd offer one of our own.

It's called the Vanagon GL. And it's first class all the way.

From the seven luxurious velour upholstered seats (each with arm rests), to the thick carpeting everywhere you step. To the magazine packets. To the overhead reading lights.

To the European styling and color coordinated interiors in rich browns. Or royal blues.

Even the ride is nice. It has independent suspension and extra soundproofing to make any journey smoother and quieter.

Whether it's a trip to the Grand Canyon. Or just down the street to Ralph's.

What's more, the Vanagon GL is incredibly fun to drive. All 200 cubic feet of it. It handles better than a lot of cars.

And, if you consider the optional diesel* engine, you might save enough money riding our way, to go just about anywhere you want flying theirs.

Nothing else is a Volkswagen.

© 1982 VOLKSWAGEN OF AMERICA, INC.

EPA estimated 29 mpg. Use for comparison only. Actual mileage varies with speed, trip length and weather.

"YOU CAN ALWAYS TRUST THE TASTE OF A BOLLA"

—Franco Bolla

BOL
VALPOLICE
FRABO S.P.A.
VERONA
QUALITA SUPERIORE
1978
QUALITA SUPERIORE
1977
BOLLA
VENDEMMIA
VINTAGE
1979
BOLLA
NET CONTENTS 750 ML
ALCOHOL
BY VOL
TREBBIANO
di APRILIA
DENOMINAZIONE DI ORIGINE CONTROLLATA
ITALIAN DRY WHITE WINE
PRODUCED AND BOTTLED IN APRILIA - ITALY
BY
CANTINE COLLI DEL CAVALIERE FOR
FRABO S.P.A.
VERONA-ITALIA

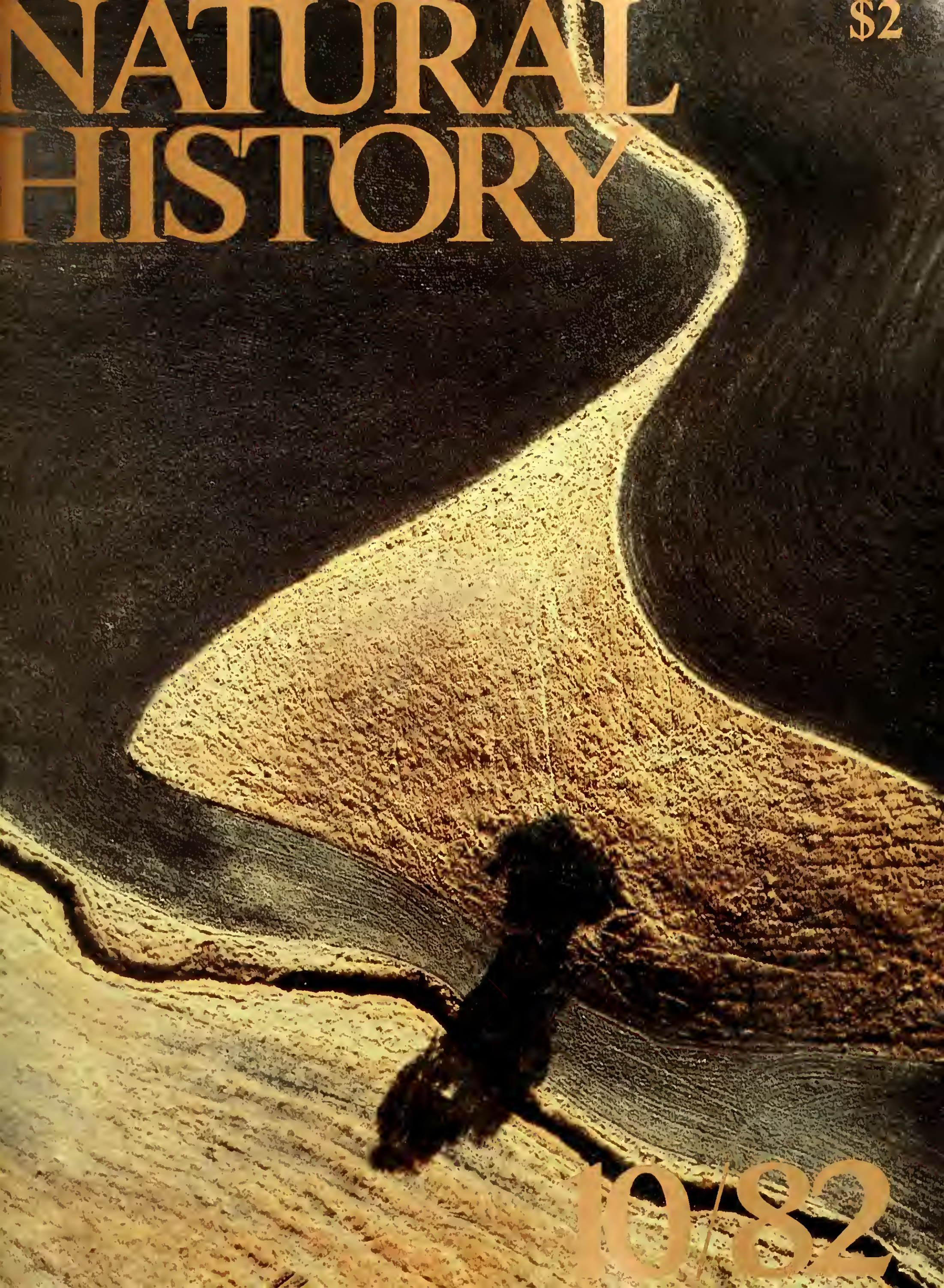
"Why do so many people prefer the Bolla family of great wines?

"Taste. Not just exceptional taste, but exceptional taste, bottle after bottle. So whether you choose the full-flavored Valpolicella, the mellow Bardolino, the crisp, refreshing Soave or the light, dry Trebbiano, you won't be disappointed. No matter how many times you choose it. After all, when you're a Bolla, you don't let your friends down."

FROM THE BOLLA
FAMILY OF GREAT WINES.
IMPORTED BY THE JOS. GARNEAU CO., N.Y., N.Y.

NATURAL HISTORY

$2



10/82

Executive Drinking Glass.

A Waterford goblet
nourishes the
executive soul.
It is never half empty,
but half full.
Blown by mouth and cut
by hand with heart,
a Waterford goblet
spruces up a desk
like flowers in bloom.
Its executive splendor
tells people who you are.
When it pours, you reign.

Waterford®

Give one to the executive you admire.
Complimentary booklet. Waterford Crystal,
225 Fifth Avenue, NY 10010

Photo: Pesin

NATURAL HISTORY

Vol. 91, No. 10, October 1982

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director
David D. Ryus, Vice-President

4 **Authors**

8 **The Making of Alaskan Oil Fields** *Les Magoon*
Where to drill for oil.

20 **This View of Life** *Stephen Jay Gould*
The Hottentot Venus

28 **Sleeping As the World Turns** *Martin C. Moore-Ede*
Research on internal clocks may ease the strains of shift work, but it can't cure the Monday morning blues.

38 **The Bountiful Yeoman** *Jay Anderson*
Getting by with grace in colonial New England.

50 **A Forkful of Orioles** *Photographs by José Luis Gonzâlez Grande*
Golden orioles brighten Europe's woodlands.

54 **Land of the Giant Conifers** *Richard H. Waring*
Bigger is better in the forests of the Pacific Northwest.

64 **Nautilus: Have Shell, Will Float** *Peter D. Ward*
An elegantly chambered shell helps the nautilus cruise the seabed.

70 **At the American Museum**
Margaret Mead Film Festival

74 **Books in Review**
A Lofty View

78 **Celestial Events** *Thomas D. Nicholson*

84 **Sky Reporter** *Stephen P. Maran*
Origin of the Crab Nebula

90 **A Naturalist at Large** *John D. Palmer*
Biorhythm Bunkum

98 **Additional Reading**

100 **A Matter of Taste** *Raymond Sokolov*
L.A.'s Super *Market*

Cover: *A bird's-eye view of a tree and its shadow on a partly plowed hill. Aerial photography can shape familiar objects into new, unfamiliar designs. Photograph by William Garnett. Story on page 74.*

Alan Ternes, Editor
Managing Editor: Erik Eckholm
(Judith Friedman, on leave)
Thomas Page, Designer
Board of Editors: Carol Breslin,
Sally Lindsay, Frederick Hartmann,
Vittorio Maestro, Rebecca B. Finnell
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
E. Kay Danzig, Art Asst.
Kay Zakariasen, Picture Editor
Ann Finch, Editorial Asst.
Lillian Berger

L. Thomas Kelly, Publisher
Bradford D. Smith, Business Manager
Ernestine Weindorf, Asst. to the Publisher
Carol A. Midkiff
Cary Castle, Circulation Manager
Jeff Pieper, Assoc. Circulation Mgr.
Ramón E. Alvarez, Asst. Circulation Mgr.
Frank Stevens, Asst. Fulfillment Mgr.
Frederick E. Grossman, Production Manager
Debra Buck McCord, Asst. Production Mgr.
Elaine M. Callender, Advtg. Production Mgr.
Douglas J. Preston, Publications Manager

NATURAL HISTORY *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Subscriptions: $15.00 a year. In Canada and all other countries: $20.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.* *Copyright © 1982 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of* Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.* Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225

Subscription orders, change of
address notices, undeliverable copies,
and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

If it's the best telecommunications system on earth, why on earth change it?

If you've ever tried to make a telephone call anyplace else on earth, you know what you've got in America. The best telecommunications system in the world.

But now you've heard the Bell System is on the verge of major changes. Changes in how we're organized. Changes in the way you can choose to do business with us.

Why change something that works?

There's a very good reason. The telecommunications business itself has changed.

For most of our history, the Bell System has had one overriding goal: universal service. Dependable telephone service at reasonable rates for everyone who wanted it.

Bolstering that goal were government policies determining that telephone companies would operate differently from most American companies. Within many areas of the country, we were to be the exclusive supplier of telecommunications services.

And since the Bell System didn't operate in a competitive market, its rates and profits were strictly regulated by the government. But today the goal of universal service has been achieved. Over 96% of American households have telephone service.

Now regulators and legislators in this country are looking more to the marketplace and competition, rather than to regulation, to decide who will provide competitive services and equipment and how they will be priced. In part, this stems from an increasing sentiment in this country for the deregulation of major industries.

But perhaps most important is the fact that technology has changed the future of telecommunications. We are about to enter a new era–the Information Age. The technology of communications gradually has merged with that of computers. The marriage of these two technologies offers the potential for an impressive array of new customer services. However, the blending of these two technologies has also blurred the boundaries between a traditionally regulated industry–communications–and the unregulated data-processing industry.

The combination of all these factors has led to a rethinking of public policies on telecommunications. These changes will require some changes in the Bell System. But we can assure you that your telephone service will still be the best telecommunications system on earth.

Along with your local Bell telephone company, we'll be telling you about any changes as they occur. In ads like this.

In each of these ads you'll find a telephone number. That number is an important part of our "Let's Talk" program.

This program has been set up by the Bell System to help you understand exactly what the changes at the Bell System will mean for you right now. And in the future.

Call us. At 1 800 555-5000.

There'll be somebody to talk to. Somebody to help you. To answer your questions. To get you information.

So call us. **Let's talk.**

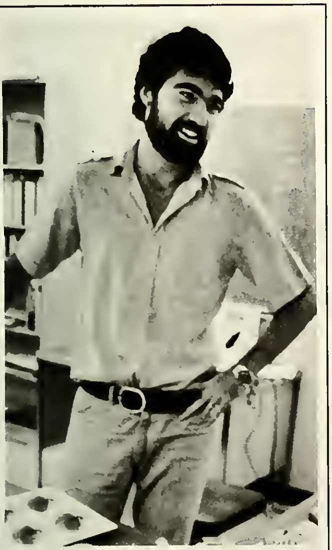
Bell System

Authors

Les Magoon is a petroleum geologist for the U.S. Geological Survey. He has been with that agency since 1974, and during that time has made at least eight field trips to study sedimentary basins where oil fields have already been discovered in Alaska. His research on the origin of oil and gas has been divided between Prudhoe Bay in the north, where he was involved in a large drilling project, and Cook Inlet in the south. Magoon's studies are primarily concerned with determining the likelihood of finding additional oil and gas reserves in Alaska. Prior to his employment at USGS, he worked for eight years for the Shell Oil Company. Because of his specialty, Magoon tends to think of Alaska in terms of sedimentary basins and fold belts. Often asked if he really finds "a bunch of dirty old rocks" interesting, his answer is, "I do."

"Ever since my first job with the Forest Service in Idaho nearly thirty years ago, I have marveled at the size of western trees," says **Richard H. Waring**. But only in the past ten years or so have Waring and other scientists begun to understand in detail how the forests of giant conifers in the Pacific Northwest developed and how they are structured. Professor of forest science at Oregon State University in Corvallis, Waring has also been led by his interest in forest ecosystems to the forests of Austria, Germany, Scotland, and Scandinavia. His research activities are varied and include the effects of stress on the allocation of carbohydrates in vascular plants, and the influence of insect defoliators, root rots, and bark beetles in forests.

In the early 1970s, **Jay Anderson** worked as a consultant at Plimoth Plantation in Massachusetts, where he experienced the problems of seventeenth-century agriculture and food preservation firsthand. Professor of folklore and historic preservation in the graduate program in folk studies at Western Kentucky University, Anderson is currently writing a book on "living history," the use of cultural simulation for research and interpretation. Anderson has done research in Great Britain, Uganda, rural Pennsylvania, Iowa, and Kentucky. For recreation, he enjoys cooking and serving traditional foods. He received his M.A. and Ph.D. in folklore and folk life from the University of Pennsylvania.



Textbooks on the subject have maintained that nautiluses come to the ocean surface at night, rising from the depths in a daily migration pattern. **Peter D. Ward** made a series of night dives off New Caledonia to test that assertion. He discovered that "as usual, the textbooks are wrong." An associate professor in the Department of Geology at the University of California, Davis, Ward will continue his research on buoyancy regulation in nautiluses and begin studies on speciation in these shelled cephalopods. A former member of Friends of the Cephalopods, he writes, perhaps cryptically, that "these are terrible creatures . . . all are cannibals . . . they belong in San Francisco."

CHIVAS BROS
PRODUCED IN SC
IMPORTED
LOCHAN ORA
LIQUEUR

The Chivas Regal of Liqueurs.

Chivas Brothers make the world's finest Scotch. And the same renowned Chivas quality and tradition goes into its equally-regal Lochan Ora Liqueur. With a unique taste all its own, Lochan Ora is to be lingered over—sipped slowly, savored fully. It's expensive but, then, good taste invariably is.

Lochan Ora.
The Imported Liqueur from Chivas Brothers.

[illegible] PROOF • IMPORTED BY GENERAL WINE & SPIRITS CO. N.Y., N.Y.

In today's demanding, high-pressure world, moments of sheer relaxation are an essential part of a healthy lifestyle.

Providing those moments is Bally's business.

A leader throughout the amusement industry, Bally makes those needed opportunities for relaxation available conveniently and inexpensively, through its family amusement centers, family amusement restaurants, theme parks, and electronic video games.

For a few minutes, or a few hours, families can lose themselves in an exciting world of fantasy, and enjoy the immeasurable benefits of a brief 'vacation' from the pressures of modern living.

And young people can come into contact with the advanced micro-computer technology that makes video games possible, and gain a glimpse of a career field with boundless opportunities.

re-lax-a-tion

(A relaxing or recreative state, activity or pastime)

PAC-MAN
MIDWAY
ALADDIN'S CASTLE
PAC-MAN

Today, more than ever, relaxation is indeed an essential part of the good life. And relaxation is the heart of Bally's business.

Fun is our business.

With almost 400 locations nationwide, Bally's Aladdin's Castle chain of family amusement centers makes inexpensive recreation conveniently available to families across America.

Bally®

Bally Manufacturing Corporation
2640 W. Belmont Avenue
Chicago, Illinois 60618

The Making of Alaskan Oil Fields

When certain preconditions are met, commercial accumulations of oil and gas are possible

by Les Magoon

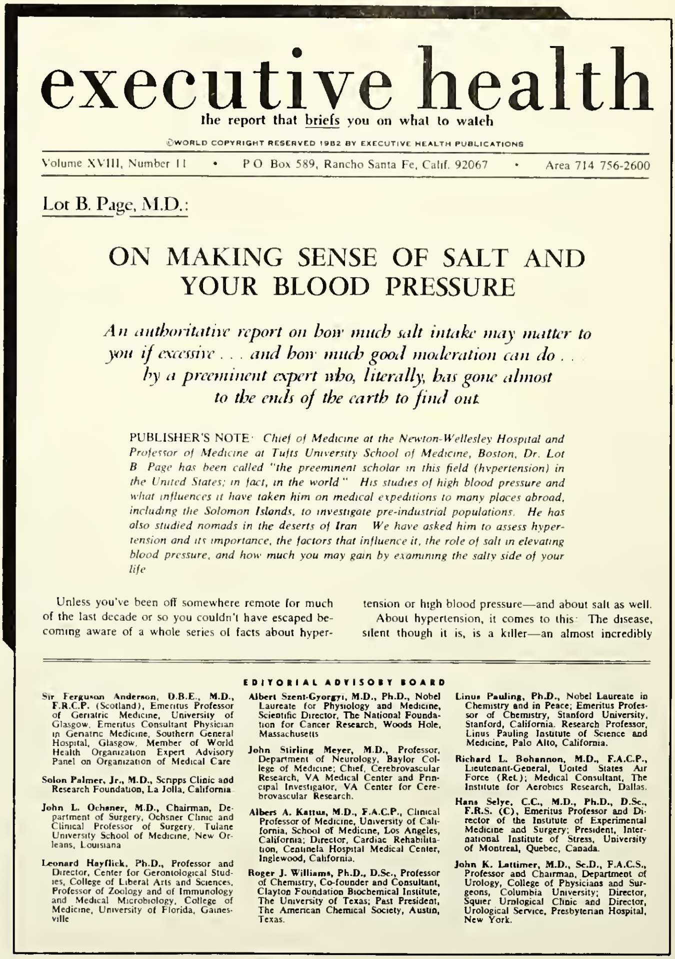
In 1867 the United States purchased Alaska from Russia for $7,200,000. The area embraces 566,432 square miles, including a landmass of 551,849 square miles and a string of islands that stretches 1,100 miles westward in the North Pacific Ocean. If superimposed on the lower forty-eight states, Alaska would reach across the country from the coast of Georgia to the coast of California and as far north as Montana.

When it was bought, the huge area was largely unexplored and unpopulated. The purchase was negotiated by then Secretary of State William H. Seward, and for many years the territory, although containing spectacular scenery and a variety of wildlife, was popularly referred to as "Seward's Folly." But in time, with the discovery of gold and various other natural resources, Alaska came to be regarded as a valuable addition to the national wealth. In 1957 an oil field estimated to contain 225 million barrels was found in the Kenai Peninsula, adjacent to Cook Inlet on the southern coast of the territory. This discovery was one factor that led to Alaska becoming the forty-ninth state in 1959. Then on January 1, 1968, an even bigger oil field was discovered on the Arctic Plain in the Prudhoe Bay area of the

At an offshore oil production platform in Cook Inlet, gas is flared for safety. A helicopter pad is in the foreground; living quarters are at right. This "little city" is designed to withstand fast tidal currents and floating winter ice.

Les Magoon

Keep Your Middle-Age Young



executive health

the report that briefs you on what to watch

©WORLD COPYRIGHT RESERVED 1982 BY EXECUTIVE HEALTH PUBLICATIONS

Volume XVIII, Number 11 • P O Box 589, Rancho Santa Fe, Calif. 92067 • Area 714 756-2600

Lot B. Page, M.D.:

ON MAKING SENSE OF SALT AND YOUR BLOOD PRESSURE

An authoritative report on how much salt intake may matter to you if excessive . . . and how much good moderation can do . . by a preeminent expert who, literally, has gone almost to the ends of the earth to find out

PUBLISHER'S NOTE: *Chief of Medicine at the Newton-Wellesley Hospital and Professor of Medicine at Tufts University School of Medicine, Boston, Dr. Lot B Page has been called "the preeminent scholar in this field (hypertension) in the United States; in fact, in the world" His studies of high blood pressure and what influences it have taken him on medical expeditions to many places abroad, including the Solomon Islands, to investigate pre-industrial populations. He has also studied nomads in the deserts of Iran We have asked him to assess hypertension and its importance, the factors that influence it, the role of salt in elevating blood pressure, and how much you may gain by examining the salty side of your life*

Unless you've been off somewhere remote for much of the last decade or so you couldn't have escaped becoming aware of a whole series of facts about hypertension or high blood pressure—and about salt as well.

About hypertension, it comes to this: The disease, silent though it is, is a killer—an almost incredibly

EDITORIAL ADVISORY BOARD

Sir Ferguson Anderson, O.B.E., M.D., F.R.C.P. (Scotland), Emeritus Professor of Geriatric Medicine, University of Glasgow, Emeritus Consultant Physician in Geriatric Medicine, Southern General Hospital, Glasgow, Member of World Health Organization Expert Advisory Panel on Organization of Medical Care

Solon Palmer, Jr., M.D., Scripps Clinic and Research Foundation, La Jolla, California

John L. Ochsner, M.D., Chairman, Department of Surgery, Ochsner Clinic and Clinical Professor of Surgery, Tulane University School of Medicine, New Orleans, Louisiana

Leonard Hayflick, Ph.D., Professor and Director, Center for Gerontological Studies, College of Liberal Arts and Sciences, Professor of Zoology and of Immunology and Medical Microbiology, College of Medicine, University of Florida, Gainesville

Albert Szent-Gyorgyi, M.D., Ph.D., Nobel Laureate for Physiology and Medicine, Scientific Director, The National Foundation for Cancer Research, Woods Hole, Massachusetts

John Stirling Meyer, M.D., Professor, Department of Neurology, Baylor College of Medicine; Chief, Cerebrovascular Research, VA Medical Center and Principal Investigator, VA Center for Cerebrovascular Research.

Albert A. Kattus, M.D., F.A.C.P., Clinical Professor of Medicine, University of California, School of Medicine, Los Angeles, California; Director, Cardiac Rehabilitation, Centinela Hospital Medical Center, Inglewood, California.

Roger J. Williams, Ph.D., D.Sc., Professor of Chemistry, Co-founder and Consultant, Clayton Foundation Biochemical Institute, The University of Texas; Past President, The American Chemical Society, Austin, Texas.

Linus Pauling, Ph.D., Nobel Laureate in Chemistry and in Peace; Emeritus Professor of Chemistry, Stanford University, Stanford, California. Research Professor, Linus Pauling Institute of Science and Medicine, Palo Alto, California.

Richard L. Bohannon, M.D., F.A.C.P., Lieutenant-General, United States Air Force (Ret.); Medical Consultant, The Institute for Aerobics Research, Dallas.

Hans Selye, C.C., M.D., Ph.D., D.Sc., F.R.S. (C), Emeritus Professor and Director of the Institute of Experimental Medicine and Surgery; President, International Institute of Stress, University of Montreal, Quebec, Canada.

John K. Lattimer, M.D., Sc.D., F.A.C.S., Professor and Chairman, Department of Urology, College of Physicians and Surgeons, Columbia University; Director, Squier Urological Clinic and Director, Urological Service, Presbyterian Hospital, New York.

Have you ever asked yourself, "What keeps well people well?" Medical men have long concentrated upon sick people and how to get them well . . . not upon well people and how to keep them well. Now many top research scientists are concentrating their efforts on *preventive* medicine . . . how to keep well people well.

Discover what *research* scientists now know about how to take the best care you can of the only *body* you will ever have!

May we suggest that you get the benefits of this new research for yourself? Do as so many thousands of executives do. Subscribe to Executive Health Report. The members of our ***Editorial Advisory Board*** are among the world's most distinguished authorities on *preventive medicine.* Their wise advice can help you not only live longer but enjoy those extra years! (note their high qualifications)

Executive Health Report is not sold on newsstands but only by private subscription at $30 (U.S. Funds) a year in the U.S.A. and its possessions, Canada and Mexico. Individual reports (back issues) $3.00 per copy. All other countries $36 (air mail only). (Only International Money Order or check on U.S. bank acceptable.)

Subscribe now under this unusual introductory offer:

(1) Your choice of any three of the reports listed below ($3.00 each) FREE!

(2) If you are not satisfied with your first issue, your money will be *promptly* refunded.

Please study the reports listed here and circle your three choices:

Linus Pauling, Ph.D.: ON GOOD NUTRITION FOR THE GOOD LIFE . . . in which the two-time Nobel Laureate informs you of his personal approach . . . and his own intake of many vitamins . . . and why — for your own possible guidance — that intake differs so markedly from conventional recommendations.

Roger J. Williams, Ph.D., D.Sc.: ON YOUR STARTLING BIOCHEMICAL INDIVIDUALITY. Some amazing facts about your body you need to know if you want to understand yourself (and other people) better.

Albert Szent-Gyorgyi, M.D., Ph.D.: ON A SUBSTANCE THAT CAN MAKE US SICK (If We Do Not Eat It!) One of the world's most honored scientists, winner of the 1937 Nobel Prize for Physiology and Medicine explains the fascinating paradox of vitamins.

If you sit at a desk all day . . . How to avoid a POT-BELLY and DOUBLE-CHIN (or get rid of them for good).

Leonard Hayflick, Ph.D.: A New Theory ON THE CAUSE OF HEART DISEASE AND STROKES . . . *Vitamin B_6 may be the key.* What new research has revealed that may downgrade cholesterol as the main predisposing factor . . . and why.

New research findings ON WALKING . . . nature's own amazing "anti-age antibiotic"! Not running, not jogging, but walking is your most efficient form of exercise and the only one you can safely follow all the years of your life!

John K. Lattimer, M.D., Sc.D., F.A.C.S.: ON THAT TREACHEROUS GLAND, your prostate—especially as you approach 50.

Please use the coupon below under our special money-back guarantee.

Executive Health, Pickfair Bldg., P.O. Box 589, Rancho Santa Fe, CA 92067

Gentlemen: Enclosed is my check for $__________ for a year's subscription to Executive Health to start with this month's issue. I have circled the three $3.00 reports I am to receive free. It is understood that if I am not satisfied with my first-issue, my money will be refunded. *In addition, send me a list of some 100 other reports of yours still in print! There may be some from which I might greatly benefit and would otherwise miss.*

Firm/Name (Please print clearly)____________________

Street & No./Route____________________**Suite or Apt.**______

City, State, Country____________________**Zip**________ NHB

Les Magoon

The onshore production pad for the Prudhoe Bay oil field includes the surface locations of up to twenty wells. The Arctic ice pack, which floats over the Arctic Ocean, can be seen in the background.

Arctic Ocean. This onshore field, estimated at 9.5 billion barrels, is the largest single oil field on the North American continent. With this oil find, Alaska, already the largest state in the union, also became potentially the richest.

Certain geologic preconditions must be fulfilled if commercial accumulations of oil and gas are to develop. In the simplest terms these conditions—the same everywhere in the world where oil has been found—involve the formation of a deep sedimentary basin; the preservation of pore space in the sediment; the transformation of organic material over long periods of time; the creation of an obstruction, or trap, in the basin; the presence of heat; and a natural pipeline through which the oil and gas can rise.

Sedimentary basins are generally associated with valleys or broad flat areas. Located north of Alaska's Brooks Range is the Arctic Plain, below which is a sedimentary basin, the Colville trough. This trough contains a prism of sedimentary rock that is up to 35,000 feet (7 miles) thick and up to 350 million years old. A few small Eskimo villages, Barrow, for example, are located in this extreme northern part of the United States. North of this subsurface trough, a long linear arch of rock more than 350 million years old runs eastward from the offshore northwest of Point Barrow along the northern Alaskan coastline to the Arctic National Wildlife Refuge. Draped across this arch is the supergiant oil field of Prudhoe Bay, which represents almost one-fifth of the oil reserves in the United States.

Just to the south of the Alaska-Aleutian Range is another sedimentary basin that contains prolific accumulations of oil and gas—the Cook Inlet basin, a body of water named for Capt. James Cook, the British navigator who explored and mapped it in 1788. Anchorage, whose population of 173,000 people makes it Alaska's largest city, is located at the head of Cook Inlet. In the subsurface below the inlet and in the lowland of Kenai Peninsula, the eastern rim of the inlet, lies an elongate sedimentary basin, approximately 175 million years old, which contains up to 30,000 feet (6 miles) of sedimentary rocks. Both offshore and onshore, this basin has yielded five major oil and three gas accumulations. The proximity of these oil and gas fields to Anchorage and other cities in this

The Possibilities are Endless.

**Six-mode exposure control.
System versatility. Newer electronics
for wider applications.**

SHUTTER PRIORITY AE
APERTURE PRIORITY AE
STOPPED-DOWN AE
MANUAL
ELECTRONIC FLASH AE
Canon
A-1
CANON LENS MADE IN JAPAN
CANON LENS FD 50mm 1:1.4

The Canon A-1 is one of the world's most advanced automatic SLR cameras. Combining the finest in optical and mechanical engineering with the most sophisticated electronics, it's technology applied to give you the ultimate in creative control. At the touch of a button.

Depending on your subject, you can choose from six independent exposure modes to achieve the results you want:

1 Shutter-Priority: You select the shutter speed, to freeze the action and prevent camera shake or create an intentional blur. The A-1 automatically selects the appropriate lens opening.

2 Aperture-Priority: Control the area in focus by selecting the lens opening for the effect you want. The A-1 matches with the right speed.

3 Programmed: When you need to shoot fast, just focus. The A-1 will select *both speed and apertura* for great results.

4 Stopped-Down: For extreme close-up or specialized photography, a bellows, a microscope or almost anything can be attached to the A-1. It's still automatic.

5 Flash: Totally automatic flash photography, of course, with a wide variety of Canon Speedlites to choose from.

6 Manual: Yes. For those times when you absolutely want to do it all yourself. To experiment. To explore the possibilities.

Canon
Canon
A-1

There are over fifty fine Canon FD lenses ranging from Fish Eye to Super Telephoto, plus accessories to meet every need. If you can't photograph your subject with a Canon A-1, it probably can't be photographed.

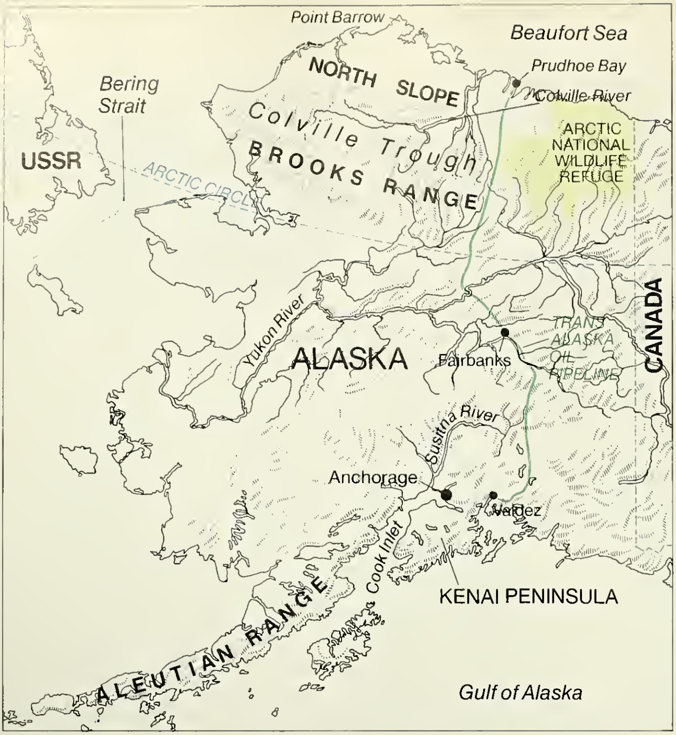
From the sophistication of its LED viewfinder display, to a ruggedness that allows up to five-frame-per-second motor drive, the Canon A-1 represents an incredible technology. At a price that makes owning one a definite possibility.

Canon® A-1

The Official 35mm Camera of the 1984 Olympic Games

Canon USA, Inc., One Canon Plaza, Lake Success, New York 11042 • 140 Industrial Drive, Elmhurst, Illinois 60126 • 5380 Peachtree Industrial Blvd., Norcross, Georgia 30071 • 123 Paularino Avenue East, Costa Mesa, California 92626 • Bldg. B-2, 1050 Ala Moana Blvd., Honolulu, Hawaii 96814 • Canon Canada, Inc., Ontario

© 1982 Canon U.S.A., Inc.



basin makes them important sources of energy to southern Alaska. The oil and gas fields at opposite ends of Alaska—Prudhoe Bay in the north and the Cook Inlet fields in the south—are crucial to the economic development of the entire state. In addition, the size of these oil and gas resources makes them of utmost importance to the United States energy budget for at least the next decade.

The sedimentary basins, where oil and gas are found, start as large water-filled depressions (oceans, seas, or lakes) that, through geologic time, eventually contain both sediment and water. As the early sediment becomes buried under more and more incoming sediment, water is squeezed out and up, allowing the sediment to compact into sedimentary rock. Sand and clay are the most common sediments dumped into the basins. When compacted, they create sandstone and shale, the most common sedimentary rocks. If these large depressions are continually fed with sediment for millions of years, they will eventually become filled with sedimentary rocks and water.

A small-scale example of a filling sedimentary basin is a lake being filled incrementally by an incoming stream. Especially during flood stage, the silt-laden stream deposits its load in the lake near the upstream shore. In hundreds or thousands of years, the depression will gradually fill to form a meadow. Another example, on a much grander scale, is the filling in of the Gulf of Mexico basin. For the last 100 million years, the Mississippi River and other, smaller rivers have been dumping sand and clay into the Gulf of Mexico. The broad coastal plain of the gulf is analogous to the aforementioned meadow; and in another 100 million years, it may be possible to walk across the Gulf of Mexico from Galveston, Texas, to Cancun in Yucatan, Mexico, without getting one's feet wet.

In northern Alaska, major streams and rivers have, over geologic time, filled in the Colville trough and spilled over the subsurface arch into the Beaufort Sea. Some 120 million years ago the coastline in that area was near the foothills of the Arctic Plain, one hundred miles south of where it is today. The sediment currently being dumped into the Beaufort Sea is continuing to build out the continental shelf. In southern Alaska, the Cook Inlet estuary is also being filled with sediment from streams and rivers.

During the last 570 million years, as the basins of the world were accumulating sediment, aquatic life thrived and evolved in the bodies of water that filled the depressions. The key organisms were the plankton, the minute plant and animal life that is the base of the food chain. Phytoplankton (plant organisms) and zooplankton (animal organisms) represent the largest biomass in the oceans. Plankton not consumed by animals in the food chain drifts to the sea bottom to be mixed into the sediment. Marine organic matter is the general term used to describe material that formerly lived in saltwater but is now preserved in sedimentary rocks. In contrast, terrestrial organic matter and sediment are dumped into basins by rivers. Pollen, spores, and other debris from living plants are common constituents of rivers. This terrestrial organic matter is swept out to sea and eventually deposited on the sea bottom with clay sediment and marine organic matter. Generally, the closer to shore, the more terrestrial organic matter will be incorporated into the clay and other extremely fine mineral matter. This mixture of organic matter and clay will, after expelling most of its water, compact into shale. One job of the petroleum geologist is to locate shales that are exceptionally rich in organic matter and have them analyzed to determine how much of the matter has been preserved and whether it is marine or terrestrial. The amount of organic matter present in the rock indicates how much oil or gas may have been generated; the type of organic matter indicates whether it will be oil or gas. Marine organic matter tends to generate oil and terrestrial matter creates gas.

The generation of oil and gas from organically rich shales depends heavily on heat and to a lesser degree on time. Heat radiates from the center of the earth. (As a well is drilled deep into the crust, the temperature increases by 10 to 30 degrees for every 1,000 feet in depth. If a 10,000-foot-deep well is drilled where the average annual surface temperature is 50°F and the temperature increases 20 degrees every 1,000 feet, then the temperature at the bottom of the hole in the earth's oven will be 250°F.) The deepest shales are the hottest; the shallowest shales the coolest. In addition, the longer that shale is buried at a certain depth, the more thoroughly it becomes cooked. But the generation of oil and gas from shales rich in organic matter is more sensitive to temperature than to time. A small increase in temperature is ten times more important than a similar increase in time.

In a tradition of superlative craftsmanship more than 500 years old . . .

On the Crest

An original sculpture . . . handcrafted of the finest Venetian glass . . . hand-signed . . . issued in limited edition.

Available exclusively from
Franklin Heirloom Glass,
at the very attractive price of $120.
Advance Reservation Deadline:
October 31, 1982.

The royal palaces of 16th-century Europe held many treasures. Rare tapestries and ornately carved furniture. Lavishly embroidered robes of state. Rich ornaments of gold and silver. And, perhaps most treasured of all—*cristallo,* the wonderful glass of Venice.

Cristallo was *the* triumph of the Venetian glassmakers with an unmatched transparency and brilliance. It was the supreme achievement of these master craftsmen, reserved for their finest *objets d'art.*

Inspired by the beautiful works of antique cristallo, Franklin Heirloom Glass has commissioned a beautiful new work of Venetian glass. An original sculpture that has a clarity and brilliance reminiscent of the cristallo so coveted by the royal art patrons of Renaissance Europe. But that possesses the strength, the simplicity of line so appreciated by today's collectors.

On the Crest is an original and dramatic work portraying a magnificent seagull poised on the crest of an ocean wave . . . created *entirely by hand* by a master craftsman in the famed Venetian glass center of Murano. No two will be exactly alike. Each will be a *true original,* and each will be *hand-signed and dated* by the skilled master who created it.

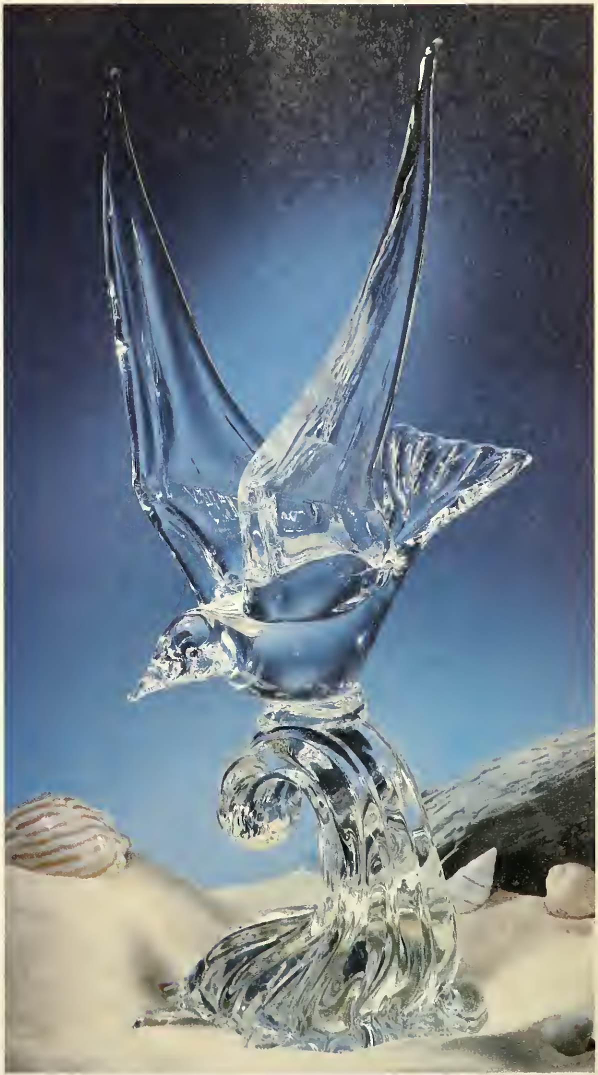
A limited edition work of exceptional beauty

On the Crest is being issued in a single, firmly limited edition. The total edition will be limited forever to the exact number of individuals who order the sculpture by the close of the issuing year—1983.

The issue price is $120, a most attractive one for an original handcrafted work of this quality. And you may pay for your sculpture in four convenient monthly installments of $30 each.

To enhance your home with this superb work of art, you need only return the attached Advance Reservation Application to Franklin Heirloom Glass, Franklin Center, Pennsylvania 19091, by October 31, 1982.

OUR PROMISE TO YOU We at Franklin Heirloom Glass take pride in the high quality of the works we produce. But we believe that our efforts should also be judged by the people we serve. Any work acquired from us may be returned for any reason within thirty days for your choice of replacement or a full refund.



SHOWN SMALLER THAN ACTUAL SIZE SCULPTURE MEASURES APPROXIMATELY 15" HIGH, 7" WIDE.

© 1982 FHG

ADVANCE RESERVATION APPLICATION

On the Crest

Franklin Heirloom Glass
Franklin Center, Pennsylvania 19091

Please accept my reservation for *On the Crest.* This original hand-signed sculpture will be handcrafted for me in the finest Venetian glass.

I understand that I need send no money at this time. I will be billed in 4 equal monthly installments of $30.* each with the first payment due before the work is sent to me.

**Plus my state sales tax*

Signature____________________

ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE

Valid only if postmarked by October 31, 1982.

Limit: One per collector.

Mr.
Mrs.
Miss____________________

PLEASE PRINT CLEARLY

Address____________________

City____________________

State, Zip____________________

5

CHINA
EXPLORE THE HIDDEN CORNERS WITH SOCIETY EXPEDITIONS.

Only Society Expeditions offers in-depth cultural and archeological programs accompanied by expert lecturer/guides.

Stay in China's most luxurious accommodations in Beijing and Shanghai—State Guest Houses formerly used only for visiting dignitaries.

Follow the historic Burma Road into southwest China, and encounter people of remarkable ethnic diversity. Visit the Tibetan-influenced Wudang lamasery on the Yellow River's upper reaches. See the terra cotta army at Xian and the 51,000 statues of Datong's stone cave temples. Sleep in a yurt camp on Inner Mongolia's grasslands.

Venture beyond customary tourist routings to areas little-seen by Westerners. Very small groups. Very High Standards.

Society Expeditions

Dept. NH8210C Broadway East, Seattle, WA 98102
Please forward your 24-page brochure.

Name

Street

City/State/Zip

Anyone for Tenons?

If your racket is tenons, doubles or singles, and you want a perfect match every time, you can learn from the professionals. They know a classic way to join two pieces of wood together is with a tenon that fits into a mortise.

Fine Woodworking magazine speaks this language to more than 200,000 readers—people seriously interested in making beautiful things out of wood. Whether you are an aspiring novice or an accomplished expert, you'll find it an especially informative magazine. It features finely detailed articles about techniques and tools, materials and design, written by master craftsmen who share their many years of woodworking experience. And it's printed on heavy paper to withstand years of reference. All back issues are in print and indexed periodically.

If you want to become a better woodworker, send $14.00 for a one-year subscription (6 issues). Or call us toll-free, 1-800-243-7252, to charge your order (Ct. residents call 1-426-8171). If you're not pleased, we'll be happy to refund.

Fine WoodWorking

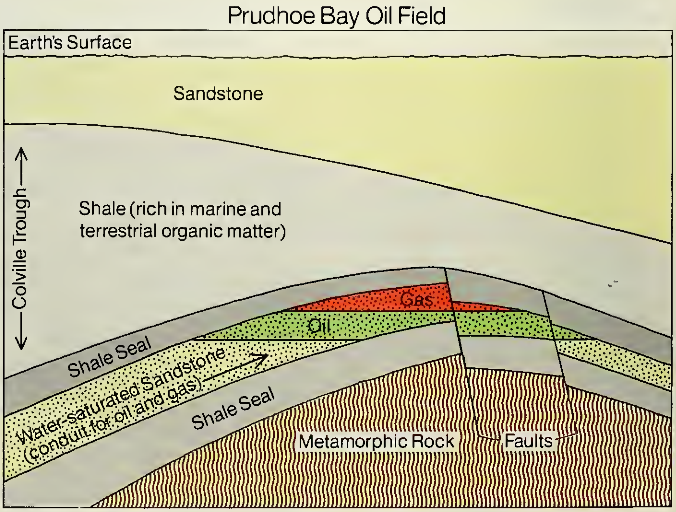
The Taunton Press
52 Church Hill Rd.
P.O. Box 355D1
Newtown
Connecticut 06470

The generation of oil and natural gas from organic matter in shales occurs sequentially. First, liquid crude oil the consistency of 40 wt motor oil is generated and forced out of the shale. Then as the organic matter in the shale gets hotter, a lighter, thinner 30 wt motor oil comes out. As the temperature rises still further because of deeper burial, the crude oil passes through the consistency of 20 wt to 10 wt motor oil. Finally, with even further heating, the crude oil forced out becomes kerosenelike and then gasolinelike. Beyond this stage, if heat continues to be applied, the natural gas with associated gasolinelike liquid is forced out of the shale. The final product is methane, or natural gas, which is quite stable to temperatures above 600°F. The complete sequence of generation usually occurs over a temperature range of 150° to 350°, a time span of five million to fifty million years, and a depth range of 8,000 to 18,000 feet. Marine organic matter, such as green and blue-green algae, yields mostly oil and very little gas and goes through the sequence described above, but terrestrial organic matter, such as woody fragments, pollen, and leaf cuticle, yields lower volumes of oil and higher volumes of gas.

As the oil and gas are being generated in the deeper, hotter part of the sedimentary basin, they move by natural means to the shallower, cooler parts of the basin where they accumulate. To understand this process, we have to return to the basin's coastline.

Sand or pebble beaches develop along the coastline where rivers empty into the basin. Surfers, swimmers, and those who have walked along a beach where breakers crash into the sand know the force of such waves and associated currents. Sand consists of small fragments of rounded rock and quartz grains and anyone who has built a sand castle knows that wet sand absorbs water. In a sedimentary basin, sand or sandstone—rock made of compacted sand—is frequently the reservoir rock in which oil and gas accumulates. And because quartz (crystalline glass) does not deteriorate or weather with age, the best sandstone reservoirs have the highest percentage of quartz. When sand is placed in a pile, numerous small gaps, called pore spaces, are left between the quartz grains. The pore space can be significant. For example, if you fill a box with sand, as much as 30 percent of the box volume is pore space. In a sedimentary basin, that empty space can hold water and sometimes oil or gas. When beach sands are swept by waves and currents into the deep parts of an ocean basin and eventually become buried and compacted to make sandstone, the pore volume is reduced, frequently to only a few percent.

Simplified geologic cross section of the Prudhoe Bay oil field, indicating one kind of oil-producing trap and reservoir. The Colville trough, a sedimentary basin, continues off to the south (left).



Alan Iselin

When all is said and done, a shoe is meant for walking. Lands' End never forgets it.

In our approach to the shoe market, Lands' End concluded that you are already well served by the "high tech" footwear available to people who walk, jog, or run for their health.

Where we can—and *do*—make a typical Lands' End contribution is in providing exceptional values in shoes that are comfortable, look good and wear well.

Even if you're not athletic, you spend 6,202 hours a year in your shoes, and half of that time you're walking. So there are three things your shoes should do for you, and Lands' End concentrates on them.

Our watchwords: comfort, fit, durability.

To make sure your shoes wear well, Lands' End uses *Vibram*, not leather, in the soles. Vibram is a synthetic composite developed by an Italian mountaineer, who selected it because it provides extremely good traction, along with light weight and durability. Vibram soles outlast leather, and do not soften or rot in wet weather.

The leathers selected for the uppers of Lands' End shoes are light in weight, yet durable too, and should reduce complaints of tiring that come from wearing too heavy a shoe.

Finally—and perhaps most important—Lands' End shoes fit. We make sure of that because—while we offer no less than 8 different styles, all are shaped on a common last. *(A last being the form around which a shoemaker builds a shoe.)* This commitment to a common last means that whatever Lands' End style you order, a size 10 is a size 10 is a size 10. This is by no means always true elsewhere.

The Lands' End difference.

Our approach to the shoe market is typical of the Lands' End approach to everything we sell—from shoes to shirts to sweaters to soft luggage and beyond.

LANDS' END
DIRECT MERCHANTS

of fine wool and cotton sweaters, Oxford button-down shirts, traditional dress clothing, snow wear, deck wear, original Lands' End soft luggage and a multitude of other quality goods from around the world.

We don't ask, "What can we do to make it cheaper?" We say, "What can we do to make it better?" A direct question—the kind we believe in getting answers to at Lands' End, Direct Merchants. Our unconditional guarantee is direct, too:

> *"If you are not completely satisfied with any item you buy from us, at any time during your use of it, return it and we will refund your full purchase price."*

Millions of people like the way we do business. Why not join them? Send for a free catalog with the coupon below or dial our toll-free number: 800-356-4444. We answer, personally, 24 hours a day, 7 days a week.

☐ **Please send free 92-page catalog.**
Lands' End Dept. P-14
Dodgevilie, WI. 53533

Name____________________
Address____________________
City____________________
State____________ Zip________

Or call Toll-free
800-356-4444
(Except Wisconsin, call 608-935-2788)

NATURAL HISTORY TOURS 1983

MASSACHUSETTS AUDUBON SOCIETY

WINTER
Texas Coast
Hawaii
East Mexico
Yucatan
Cuba
Costa Rica
Suriname
Trinidad/Tobago

SUMMER
Alaska
Winnipeg/Churchill
Montana/Western Parks
Minnesota/Prairies
Colorado
Bathurst Inlet
New Guinea/New Britain/North Solomons
Washington

SPRING
Texas
Great Smoky Mts.
Japan
Arizona
France
Mongolia/Siberia

AUTUMN
California
Europe: Fall Migration
New England/Nova Scotia
Mid-Atlantic Coast
South Africa
Australia/New Zealand/Fiji
Oaxaca, Mexico

For our 1983 brochure, please write to:
Director of Tours
Massachusetts Audubon Society
Lincoln, MA 01773

ODOR-FREE LITTER BOX

Charcoal air filter absorbs all odor!

Breathe a sigh of relief! Charcoal filtered BoodaBox® is completely odor-free, ends litter scatter and gives cats the privacy they prefer. Treat yourself to BoodaBox®, America's best selling system.

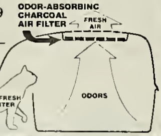
BOODABOX®

- Easy-off locking top cannot be dislodged by cats, dogs or children ■ The canopied entry is 8"x14" ■ King size litter pan is 8" deep
- Overall dimensions: 27"Lx16"Wx17"H
- Cream beige ABS plastic lets light pass into interior ■ Charcoal filters last 6 mos. Replacements, $3.95 ea. (about 2¢ a day)
- Poly Pan Liners available ■ Order forms provided with order.

$34.95 + $4 Shipping.
Add $2.27 Tax in Calif.

UNCONDITIONAL 30 DAY MONEY BACK GUARANTEE

MC/VISA CALL EXT. 9
(213) 934-1093



BOODA PRODUCTS
439 S. DETROIT ST.
DEPT. NH-102
LOS ANGELES
CA 90036

But in oil and gas reservoirs the pore volume is about 15 percent.

Some sand is deposited near the mouth of an emptying river, some is deposited along the coast as beaches, and the rest is carried by the bottom currents deep into the ocean basin to become buried sandstone. Before their pore space is significantly reduced, these sand bodies can serve as natural pipelines, bringing oil and gas up to shallower depths. As oil and gas are generated, they are forced by as yet unknown processes out of the deep shale and into the adjacent water-wet sandstone. Since oil is buoyant and floats on water, it moves up the inclined sandstone bed until it is stopped or trapped by some impermeable barrier such as a reef or a fault. The process is the opposite of the movement of water in a stream bed—water moves downhill in response to gravity, while oil moves uphill in response to buoyancy. Sealed by shale, the subsurface pipeline lets oil and gas move out of the earth's internal oven to a shallower, cooler depth where they are preserved.

The rising oil and gas are trapped in a convex shale container, or dome. These reservoirs are first filled almost entirely with sandstone and at least 15 percent with pore-space water. As oil or gas moves up the sandstone pipeline, it displaces the water at the shallowest part of the reservoir. When the oil fills up the reservoir, what spills out will move up to shallower depths. Gas moves in a like manner to oil but responds to lower pressure rather than to buoyancy.

Although simplified, this description of the origin of oil and gas in sedimentary basins outlines the necessary ingredients for an accumulation, namely, source rock, heat, pipeline, reservoir, trap, and timing. If any of these ingredients is missing, commercial accumulations of oil and gas are impossible. Because so many geologic conditions must be satisfied before a commercial accumulation of oil and gas can occur, when one does, it can be considered a natural anomaly.

Alaska contains many sedimentary basins both onshore and offshore. The Colville trough on the North Slope is one onshore basin where all the necessary geologic conditions for oil and gas accumulations exist. Here, two shales rich in marine organic matter are adjacent to a quartz-rich sandstone that acts as the pipeline and, at shallower depths, the reservoir. The shales have been heated to very high temperatures deep in the earth's oven. The organic matter has been converted to oil and forced out of the shale into the sandstone pipeline. In the pipeline the oil moves by buoyancy up through the water in the pore space of the pipeline to the shallower depth reservoir. Here the oil is trapped by a complex combination of faults, a dome, and an impermeable barrier to form the Prudhoe Bay oil field. Even though this oil is continually leaking out of or overflowing from the trap, new oil is slowly coming up the pipeline to replenish the reservoir.

The oil and gas accumulations in the Cook Inlet basin in the south are located both onshore and offshore. Here, too, all the geologic conditions have been met, as on the North Slope, but the size of the accumulations is not on such a grand scale because the basin is smaller.

Oil started flowing through the trans-Alaska pipeline in 1977. As of the end of 1981, Prudhoe Bay had produced 2,200 million barrels of oil, which leaves about 7,300 million barrels for future use. Producing almost 600 million barrels a year gives the field at least another twelve years of productive life. In contrast, the Cook Inlet requires five oil fields to produce slightly more than 30 million barrels of oil a year, and the estimated reserve will last for only two or three more years before production starts to decline. With 165 million barrels left from an original 955 million barrels of oil, Cook Inlet will be productive, at a declining rate, well into the 1990s.

To put the Alaskan annual oil production into perspective, the United States produces about 3.2 billion barrels and consumes almost 5.8 billion barrels of oil a year. Thus 20 percent of U.S. production and more than 10 percent of U.S. consumption comes from Alaska. Based on today's U.S. oil reserves of almost 55 billion barrels, there is enough oil at the present rate of production to last about ten years. However, industry exploration does result in new oil finds, and technological developments will extend the life of other fields, so production in Alaska and the remainder of the United States will diminish only gradually over the coming decades, easing the necessary transition to alternative energy sources.

To date, oil and gas fields have been located by trial and error, not by direct methods. They cannot be seen before they are drilled and must be found in an opaque structure of sedimentary rock. Because oil and gas fields have to be located blind, it is especially difficult to predict where future Alaskan oil and gas accumulations may be discovered. But the search will undoubtedly continue, especially offshore.

People may be curious as to why oil companies are so interested in offshore areas. One reason is that pertinent seismic data—information on underground strata

Now You Can Own an Oriental Masterwork of the Treasured Art of Chokin

松 Featuring a Chokin centerpiece, hand-gilded with pure, 24K gold and silver.

天 Brought to the Western World for the first time ever as a porcelain, limited-edition work.

秋 Celebrating nature's symbols, as honored by the Japanese Floral Calendar for centuries, in a 23K gold border design.

To the Japanese, the fresh evergreen pine represents prosperity ... and the gentle wading crane is a symbol of longevity. These images prevail on the traditional Japanese Floral Calendar from January 1 to 15, as wishes for the new year ahead.

The symbols of nature represented in the Japanese Floral Calendar have been handed down across scores of generations, and today the Japanese continue to feel a true reverence for the Floral Calendar.

In the same manner, the sensitive art of Chokin has been handed down from father to son for more than 700 years. Created by etching solid copper and gilding it with gold and silver, the stunning Chokin master-works first appeared on the armaments of the mighty Samurai warriors in the late 12th Century.

Unfortunately, today there are few surviving masters of the Chokin art style. But one of these great artists, Shuho, was retained to design and hand-engrave the "New Year's Day" art of pine and crane exclusively for The Hamilton Collection.

Each Chokin Image Created by Hand

The re-creation of Shuho's floral calendar images involves performing many delicate operations for each individual plate. Master craftsmen hand-gild each central image, using 24K gold, copper and silver. This central piece is then fused to a plate body of pure, glistening white porcelain. In addition, a ⅜″–wide band of 23K gold borders the plate body, enhanced by etched symbols from the Floral Calendar.

Thus, "New Year's Day" combines the beauty of a magnificent Oriental art with the mystique of a centuries-old Japanese tradition. The result is a masterwork that will accent your home with elegant distinction.

A Strictly Limited Edition

Because of the difficult hand work involved in the creation of each "New Year's Day" plate, the firing period must be *strictly* limited to ten days only. And when this edition closes, no further plates will ever be created. Because of this, a further limit of two plates per customer must be enforced. Each plate will be hand-numbered, attesting to its place in the edition.

New Year's Day is the first issue of a 12-plate series honoring all the months in the Japanese Floral Calendar. By ordering now, you will also be guaranteed the right to acquire all subsequent 11 plates in the collection, and at the same, guaranteed issue price of only $32.50 per plate. *But there will never be any obligation to acquire or even to receive another plate.* Furthermore, you may inspect "New Year's Day" in your home for 30 days, with the option of returning it at any time during that period for a prompt and unquestioned refund of everything you have paid.

NEW YEAR'S DAY. ACTUAL SIZE 5⅞″.

Today a great many discerning collectors and lovers of fine art are realizing the pride and pleasure of acquiring Oriental treasures such as "New Year's Day." And because "New Year's Day" is the first limited-edition porcelain masterwork ever to feature Chokin art, demand for this first issue is expected to accelerate rapidly in the next few weeks, and late applicants could be turned away.

Therefore, an early reservation is your only guarantee that you will own the beautiful Chokin art of "New Year's Day." So please return your Reservation Form *today* to The Hamilton Collection, 1 Charter Plaza, P.O. Box 2567, Jacksonville, FL 32203.

PREFERRED RESERVATION FORM

To Assure Acceptance, Mail by: Nov. 15, 1982.

I accept your invitation to acquire "New Year's Day," first issue in "Japanese Floral Calendar" collection of 12 plates combining Chokin precious metal engraving and fine porcelain, bordered in 23K gold. Hand-numbered with a numbered certificate. 5⅞″ diameter. Limit: two plates per collector.

Yes, I wish to purchase ____ (1 or 2) "New Year's Day" plate(s) at $32.50* each, for a total of ________ ($32.50* or $65.00*)

Please Check one:

☐ I enclose full payment by check or money order. 29482

☐ Charge my credit card ☐ Visa ☐ MasterCard ☐ American Express

Full Account Number ____________ Expires ________

Name ____________

Address ____________

City ____________ State ________ Zip ________

Signature ____________

Charge orders must be signed to be valid

All applications subject to acceptance by The Hamilton Collection. 1786 HC 376-N

Please allow six to eight weeks for delivery.

*Florida residents please add $1.63 per plate, sales tax. Illinois residents add $1.95 per plate, state and local tax.

The Hamilton Collection

1 Charter Plaza, P.O. Box 2567, Jacksonville, FL 32203

Better Than Jogging

NordicTrack

Jarless Total Body Cardiovascular Exerciser Duplicates X-C Skiing for the Best Motion in Fitness

The enjoyable sport of cross-country skiing is often cited by physiologists as the most perfect form of cardiovascular exercise for both men and women. Its smooth, fluid, total body motion uniformly exercises more muscles and higher heart rates seem easier to attain than when jogging or cycling NordicTrack closely simulates the pleasant X-C skiing motion and provides the same cardiovascular endurance-building benefits—right in the convenience of your home. Makes a year round, consistent exercise program easily attainable. Eliminates the usual barriers of time, weather, chance of injury, etc Also highly effective for weight control

Better Than Running
NordicTrack gives you a more complete work out—conditions both upper body and lower body muscles at the same time Fluid, jarless motion will not cause joint or back pains as jogging or running often does

More Effective Than Exercise Bikes
NordicTrack's stand-up skiing motion more uniformly exercises large leg muscles and also adds important upper body exercise Higher pulse rates, necessary for building fitness, seem easier to attain because the work is shared by more muscle mass The NordicTrack also keeps more muscles in tone

Even Better Than Swimming
NordicTrack more effectively exercises the largest muscles in the body, those located in the legs and buttocks These muscles' main function is to lift and propel the body in the standing position. However, when swimming, the body is supported by the water, thus preventing these muscles from being effectively exercised The stand up exercising position on the NordicTrack much more effectively exercises these muscles

A Proven, High Quality Durable Product
Ruggedly constructed, NordicTrack is quiet, motorless and folds compactly for storage Separately adjustable arm and leg resistances NordicTrack is in its 6th year of production and is used in thousands of homes and many companies We manufacture and sell direct Two year warrantee, 15 day trial period with unconditional return privilege.

For more information write or call
TOLL FREE 1-800-328-5888
8 AM-5 PM MON.-FRI.
PSI 124 L Columbia ct. Chaska, MN 55318
Minnesota 612-448-6987

Les Magoon

Concerned with increasing their oil production, oil companies are expanding their activities on offshore sites. This drilling platform was erected in Cook Inlet, Alaska.

derived from the analysis of shock waves—is easier to acquire offshore than onshore; another is that large offshore areas can be made available by the government. But the primary reason is that more offshore sedimentary basins are in a good state of preservation. Onshore sedimentary basins are above sea level, so they are susceptible to eventual destruction by erosion. Over geologic time erosion has destroyed many more oil and gas fields than exist today. Oil seeps, heavy oil deposits, and tar belts are frequently the products of erosion. In offshore areas, the continental shelf is continually receiving sediment from rivers, thereby building up the sedimentary basins. Here, if the sedimentary basin is old enough and deep enough, oil and gas accumulations are more likely to occur and be preserved. This is an important reason why much of the interior of Alaska has very poor prospects for oil and gas fields and why certain areas of offshore Alaska are still excellent locations for finding oil and gas. ☐

As they soar, so do hearts.

Without voice, their bodies sing songs. Without words, their movements tell stories. Using only motion, ballet dancers can move others. Now,

Ballet West, an emerging force in American ballet, is lifting this art form to greater heights. As a major touring company, its members enrich the lives of thousands of Americans. By achieving what most find impossible, they make the heart soar. Phillips Petroleum is glad to help fund them because they help lift the spirits of us all. PHILLIPS 66

For additional information contact Ballet West, 50 West 200 South, Salt Lake City, Utah 84101.

The Hottentot Venus

A sensation from Piccadilly to Paris, she drew crowds from all classes, including scientists

by Stephen Jay Gould

I had a little friend in nursery school. I don't even remember her name. But I do recall that I offered her some secret advice one day at the playground. I told her that the enormous surrounding creatures known as adults always looked up when they walked, and that we little folk would therefore find all manner of valuable things on the ground if we only kept our gazes down. Were my paleontological predispositions already in evidence?

Carl Sagan and I both grew up in New York, both interested in biology and astronomy. Since Carl is tall and chose astronomy, while I'm short and chose paleontology, I always figured that he'd be looking up (as he did with some regularity in "Cosmos"), while I'd be sticking to my old but good advice and staring at the ground. But I one-upped him (literally) last month in Paris.

A few years back, Yves Coppens, professor at the Musée de l'Homme, took Carl on a tour of the museum's innards. There, on a shelf in storage, he found the brain of Paul Broca floating in Formalin in a bell jar. He wrote a fine essay about this visit, and then used it as the title piece of his book *Broca's Brain.* A few months ago, Yves took me on a similar tour. I held the skull of Descartes and of our mutual ancestor, the old man of Cro-Magnon. I also found Broca's brain, resting on a shelf and surrounded by other bell jars holding the brains of his illustrious scientific contemporaries—all white and all male. Yet I found the most interesting items on the shelf just above. Perhaps Carl never looked up.

This area of the museum's "back wards" holds Broca's collection of anatomical parts, to which he later made his own generous and posthumous contribution. Broca, a great medical anatomist and anthropologist, embodied the great nineteenth-century faith in quantification as a key to objective science. If he could collect enough human parts from enough human races, the resultant measurements would surely define the great scale of human progress, from chimp to Caucasian. Broca was not more virulently racist than his contemporary scientists (nearly all successful white males, of course); he was simply more assiduous in accumulating irrelevant data, selectively presented to support an a priori viewpoint.

These shelves contain a ghoulish potpourri: severed heads from New Caledonia; an illustration of foot binding as practiced upon Chinese women—yes, a bound foot and lower leg, severed between knee and ankle. And, on the shelf just above the brains, I saw a little exhibit that provided an immediate and chilling insight into nineteenth-century *mentalité* and the history of racism: in three smaller jars, I saw the dissected genitalia of three Third-World women. I found no brains of women, and neither Broca's penis nor any male genitalia grace the collection.

The three jars are labeled *une négresse, une péruvienne,* and *la Vénus Hottentotte,* or the Hottentot Venus. Georges Cuvier himself, France's greatest anatomist (see my column of June 1981), had dissected the Hottentot Venus upon her death in Paris late in 1815. And he went right to the genitalia for a particular and interesting reason, to which I will return after recounting the tale of this unfortunate woman.

In an age before television and movies made virtually nothing on earth exotic, and when anthropological theory assessed as subhuman both malformed Caucasians and the normal representatives of other races, the exhibition of unusual humans became a profitable business both in upper-class salons and in street-side stalls (see Richard D. Altick's *The Shows of London,* Harvard University Press, 1978, or the book, stage, and screen treatments of the "Elephant Man"). Supposed savages from faraway lands were a mainstay of these exhibitions, and none was so famous as the Hottentot Venus. (The Hottentots and Bushmen are closely related, small-statured people of southern Africa. Traditional Bushmen, when first encountered by Europeans, were hunter-gatherers, while Hottentots were pastoralists who raised cattle. Anthropologists now tend to forgo these European and somewhat derogatory terms and to designate both groups collectively as the Khoi-San peoples, a composite word constructed from each group's own name for itself.) The Hottentot Venus was a servant of Dutch farmers near Capetown, and we do not know her actual group membership. I will refer to her by her given name of Sartje.

Hendrick Cezar, brother of Sartje's "employer," suggested a trip to England for exhibition and promised to make Sartje a wealthy woman thereby. Lord Caledon, governor of the Cape, granted permission for the trip but later regretted his decision when he understood its purposes more fully. (Sartje's exhibition aroused much debate and she always had supporters, disgusted with the display of humans as animals; the show went on, but not to universal approbation.) She arrived in London in 1810 and immediately went on exhibition in Piccadilly, where she was a sensation, for reasons soon to be discussed. A member of the African Association, a benevolent society that petitioned for her "release," described the show. He first encountered Sartje in a cage on a platform raised a few feet above the floor:

> On being ordered by her keeper, she came out. . . . The Hottentot was produced like a wild beast, and ordered to move backwards and forwards and come out and go into her cage, more like a bear in a chain than a human being.

Yet Sartje, interrogated in Dutch before a court, insisted that she was not under restraint and understood perfectly well that she had been guaranteed half the profits. The show went on.

After a long tour of the English provinces, Sartje went to Paris where an animal trainer exhibited her for fifteen months, causing as great a sensation as in England. Cuvier and all the great natural-

Enter the J&B "It Whispers" Photo Contest and win a trip to Scotland.

Once again J&B has begun the search for the photograph that whispers J&B best. If you can capture that scene, J&B will cover all expenses for a once in a lifetime trip to Scotland. In addition to the grand prize, there are over 600 other fabulous prizes that could be yours. Read on and find out how to enter.

Grand Prize

Ten-day, nine-night trip for two to Scotland, including round trip air transportation, hotel accommodations, meals, car rental, visit to J&B distillery, sightseeing plus $1,000 spending money; or $5,000 cash in lieu of the trip.

5 First Prizes

Minolta Hi-Matic AF2-M. Focuses and winds itself automatically. Includes built-in pop-up flash. Shutter release won't work unless batteries are strong and film is completely loaded. Just aim and shoot for perfectly exposed pictures.

100 Second Prizes

Kodak's Pleaser II Kodamatic Instant Camera. The handy, easy-to-use camera that lets you take big, bright instant prints that develop right before your eyes. Easy to load, no focus or exposure settings to make. Hand grip provides easy handling and carrying.

500 Third Prizes

The J&B Mirror. This distinctive J&B mirror is 22″ x 32″ in a hardwood frame. Printed in red, black and gold, it is an elegant addition to any home bar/den.

J&B
RARE
SCOTCH WHISKY

Special Offer

The first 18,000 entrants will automatically receive a "Jazz and Beethoven" record album.

J&B
Jazz & Beethoven

How to Enter

Simply clip the coupon from the bottom of the page or see your participating liquor store for an entry blank. Then take a picture of the scene, setting or view that you think whispers J&B, and send it in. Be sure to follow the rules below. Incomplete entries will be invalid.

Official Rules— No Purchase Necessary

1 To enter, submit a black-and-white or color photograph (2¼″ x 2¼″ to 8″ x 10″) of a scene that you feel "whispers." Slides and transparencies are not accepted.

2. Handprint your name, address, and zip code, on the official entry form or a plain piece of paper. Glue or tape it to the back of your photo entry. Do not write on photo, include cardboard backing to protect picture in mail. Include with your entry the answer to the following question: What do the initials "J&B" on a bottle of J&B Rare Scotch stand for? Your entry will not be eligible for judging unless this question is answered. The information needed to answer this question may be found by looking at the label of any bottle of J&B Rare Scotch. You may obtain a free label facsimile by writing to: J&B Label, P.O. Box 3028, Westbury, NY 11591.

3 Enter as often as you wish, but each entry must be mailed separately to: J&B "WHISPERS" CONTEST, P.O. Box 3052, Westbury, NY 11591 Entries must be received by December 31, 1982.

4. Entries will be judged on the basis of originality (0 to 30 points), relevance to the theme (0 to 40 points), composition (0 to 20 points), photographic technique (0 to 10 points). Winners will be selected under the supervision of National Judging Institute, Inc., an independent judging organization whose decisions are final on all matters relating to this contest. All prizes will be awarded and winners notified by mail. Prizes are not transferable or exchangeable. Only one prize to an individual or family.

5 All entries become the property of The Paddington Corporation with all rights, including the right to edit, publish and use any photo without further consideration of payment to the contestant. No correspondence about entries will be entered into, nor will photos be acknowledged or returned.

6 Before receiving a prize, each entrant must warrant his age, that the photograph was taken by himself, that he is an amateur photographer, and that he has full rights to the photograph and that it has won no previous award or competition

7. The contest is open to U S residents, except employees and their families of The Paddington Corporation, its affiliates, advertising and sales promotion agencies, liquor wholesalers and retailers, professional photographers and Don Jagoda Associates, Inc. Void where prohibited. All federal, state and local regulations apply. Taxes on prizes, if any, are the responsibility of the individual winners

8. Entrants must be of legal drinking age in the state of their residences as of September 1, 1982. For a list of major winners, send a stamped, self-addressed envelope to: J&B "WHISPERS" Winners, P.O. Box 3077, Westbury, NY 11591.

Official Entry Form

Mail your completed entry & photograph to:

J&B 2nd Annual "It Whispers" Photo Contest, P.O.
Box 3052, Westbury, NY 11591

Name______________________________

Address____________________________

City______________State________Zip______

The initials on the label of a bottle of J&B Rare Scotch stand for: ________________________

Void where prohibited. No purchase necessary.

86 Proof Blended Scotch Whisky.

© 1982 The Paddington Corp., NY NAH

ists of France visited her and she posed in the nude for scientific paintings at the Jardin du Roi. But she died of some inflammatory ailment on December 29, 1815, and ended up on Cuvier's dissecting table, rather than wealthy in Capetown.

Why, in an age deluged with human exhibitions, was Sartje such a sensation? We may offer two answers, each troubling and each associated with one of her official titles—Hottentot and Venus.

On the racist ladder of human progress, Bushmen and Hottentots vied with Australian aborigines for the lowest rung, just above chimps and orangs. (Some scholars have argued that the earliest designation applied by seventeenth-century Dutch settlers—*Bosmanneken*, or "Bushman"—was a literal translation of a Malay word well known to them—*Orang Outan*, or "man of the forest.") In this system, Sartje exerted a grim fascination, not as a missing link in a later evolutionary sense, but as a creature who straddled that dreaded boundary between human and animal and thereby taught us something about a self still present, although submerged, in "higher" creatures.

Contemporary commentators emphasized both the simian appearance and the brutal habits of Bushmen and Hottentots. In 1839, the leading American anthropologist S.G. Morton labeled Hottentots as "the nearest approximation to the lower animals.... Their complexion is a yellowish brown, compared by travellers to the peculiar hue of Europeans in the last stage of jaundice.... The women are represented as even more repulsive in appearance than the men." Mathias Guenther, in an excellent article, "The Changing Western Image of the Bushmen" (*Paideuma*, vol. 26, 1980, pp. 123–240), cites an 1847 newspaper account of a Bushman family displayed at the Egyptian Hall in London:

> In appearance they are little above the monkey tribe. They are continually crouching, warming themselves by the fire, chatting or growling.... They are sullen, silent and savage—mere animals in propensity, and worse than animals in appearance.

And the jaundiced account of a failed missionary in 1804:

> The Bushmen will kill their children without remorse, on various occasions; as when they are ill shaped, or when they are in want of food, or when obliged to flee from the farmers or others; in which case they will strangle them, smother them, cast them away in the desert or bury them alive. There are instances of parents throwing their tender offspring to the hungry lion, who stands roaring before their cavern, refusing to depart before some peace offering be made to him.

Guenther reports that this equation of Bushman and animal became so ingrained that one party of Dutch settlers, out on a hunting expedition, shot and ate a Bushman, assuming that he was the African equivalent of the Malay orang.

Cuvier's monograph of Sartje's dissection, published in the *Mêmoires du Musêum d'Histoire Naturelle* for 1817, followed this traditional view. After discussing and dismissing various ill-founded legends, Cuvier promised to present only "positive facts"—including this description of a Bushman's life:

> Since they are unable to engage in agriculture, or even in a pastoral life, they subsist entirely on hunting and pilfering. They live in caves and cover themselves only with the skins of animals they have killed. Their only industry involves the poisoning of their arrows and the manufacture of nets for fishing.

His description of Sartje herself emphasizes any point of superficial similarity with any ape or monkey. (I hardly need mention that since people vary so much, each group must be closer than others to some feature of some other primate, without implying anything about genealogy or aptitude.) Cuvier, for example, discusses the flatness of Sartje's nasal bones: "In this respect, I have never seen a human head more similar to that of monkeys." He emphasizes various proportions of the femur (upper leg bone) as embodying "characters of animality." He speaks of Sartje's small skull (no surprise for a woman four and a half feet tall), and relegates her to stupidity according to "that cruel law, which seems to have condemned to an eternal inferiority those races with small and compressed skulls." He even abstracted a set of supposedly simian responses from her behavior: "Her movements had something brusque and capricious about them, which recall those of monkeys. She had, above all, a way of pouting her lips, in the same manner as we have observed in orang utans."

Yet a careful reading of the entire monograph belies these interpretations, since Cuvier states again and again (although he explicitly draws neither moral nor message) that Sartje was an intelligent woman with general proportions that would not lead connoisseurs to frown. He mentions, in an offhand sort of way, that Sartje possessed an excellent memory, spoke Dutch rather well, had some command of English, and was learning a bit of French when she died. (Three foreign languages ain't bad for a caged brute; I only wish that more Americans could do one-third so well.) He admitted that her shoulders, back, and chest "had grace"; and with the gentilesse of his own race, spoke of *sa main charmante* ("her charming hand").

Yet Sartje's hold over well-bred Europe did not arise from her racial status alone. She was not simply the Hottentot or the Hottentot woman, but the Hottentot *Venus.* Under all the official words lay the great and largely unsaid reason for her popularity. Khoi-San women do exaggerate two features of their sexual anatomy (or at least of body parts that excite sexual feelings in most men). The Hottentot Venus won her fame as a sexual object, and the combination of supposed bestiality and lascivious fascination focused the attention of men who could thus obtain both vicarious pleasure and a smug reassurance of superiority. (Women visitors probably experienced the second benefit in sufficiently heightened form to more than offset any absence of the first.)

Primarily—for, as they say, you can't miss it—Sartje was, in Altick's words, "steatopygous to a fault." Khoi-San women accumulate large amounts of fat in their buttocks, a condition called steatopygia. The buttocks protrude far back, often coming to a point at their upper extremity and sloping down toward the genitalia. Sartje was especially well endowed, the probable cause of Cezar's decision to convert her from servant to siren. Sartje covered her genitalia during exhibitions, but her rear end *was* the show, and she submitted to endless gaze and poke for five long years. Since European women did not wear bustles at the time, but indicated by their clothing only what nature had provided, Sartje seemed all the more incredible.

Cuvier well understood the mixed bestial and sexual nature of Sartje's fascination when he wrote that "everyone was able to see her during her eighteen-month stay in our capital, and to verify the enormous protrusion of her buttocks and the brutal appearance of her face." In his dissection, Cuvier focused on an unsolved mystery surrounding each of her unusual features. Europeans had long wondered whether the large buttocks were fatty, muscular, or perhaps even supported by a previously unknown bone. The problem had already been solved—in favor of fat—by external observation, the primary reason for her disrobing before scientists at the Jardin du Roi. Still, Cuvier dissected her buttocks and reported:

> We could verify that the protuberance of her buttocks had nothing muscular about it, but arose from a [fatty] mass of a trembling and elastic consistency, situated immediately under her skin. It vibrated with all movements that the woman made.

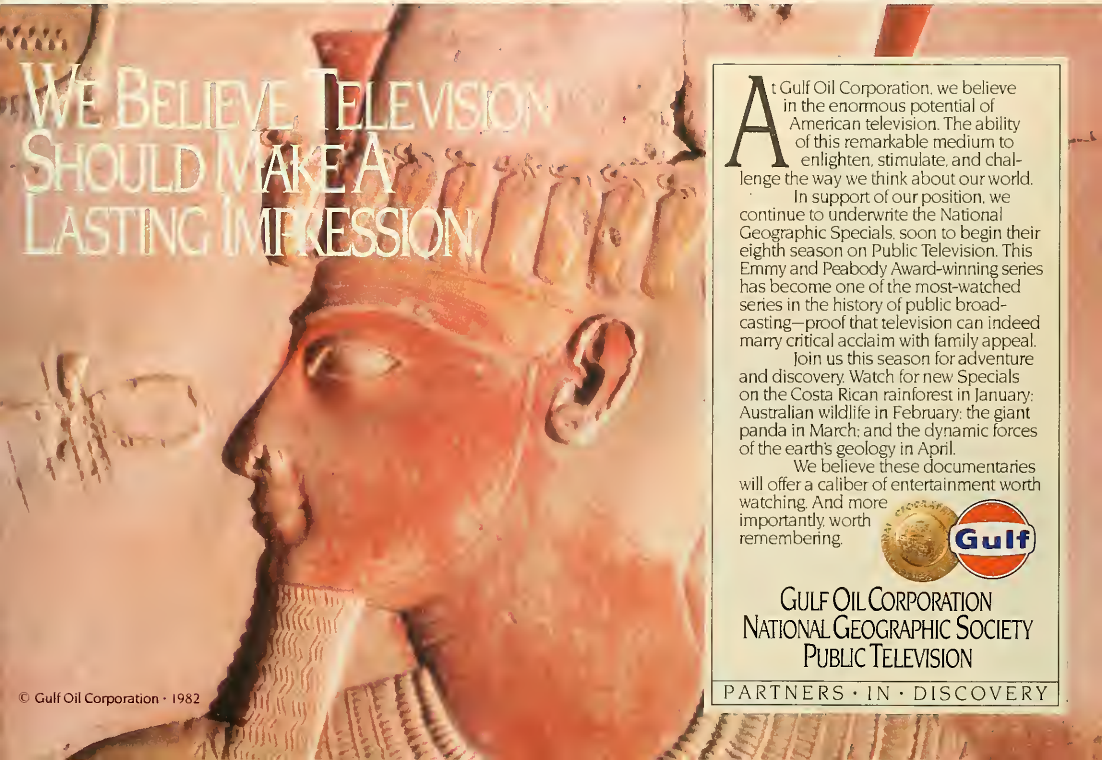
But Sartje's second peculiarity was far more enticing to scientists, all the more so because she kept it scrupulously hidden, even refusing a display at the Jardin. Only after her death would the curiosity of science be slaked.

Reports had circulated for two centuries of a wondrous structure attached directly to the female genitalia of Khoi-San women and covering these private parts with a veil of skin, the so-called *sinus pudoris*, or "curtain of shame." (If I may be permitted a short excursion into the realm of scholarly minutiae—the footnotes of more conventional academic publication—I would like to correct a standard mistranslation of Linnaeus, one that I have made myself. In his original description of *Homo sapiens*, Linnaeus provided a most unflattering account of African blacks, including the line: *feminae sinus pudoris*. This has usually been translated, "women are without shame"—a slur quite consistent with the rest of his words. Now "without shame," in Latin, should be *sine pudore*, not *sinus pudoris*. But eighteenth-century scientific Latin was written so indifferently that misspellings and wrong cases are no bar to actual intent, and the reading "without shame" has held. But Linnaeus was only saying that African women have a genital flap, or *sinus pudoris*. He was also wrong, because only the Khoi-San and a few related peoples develop this feature.)

The nature of the *sinus pudoris* had generated a lively debate, with partisans of both sides claiming eyewitness support. One party held that the *sinus* was simply an enlarged part of the ordinary genitalia; others called it a novel structure found in no other race. Some even described it as a large fold of skin hanging down from the lower abdomen itself. Cuvier resolved to find out, and made this quest the primary object of his dissection. He began his monograph by noting: "There is nothing more famous in natural history than the *tablier* (the French rendering of *sinus pudoris*) of Hottentots, and, at the same time, no feature has been the object of so many arguments." Cuvier resolved the debate with his usual elegance: the *labia minora*, or "inner lips," of the ordinary female genitalia are greatly enlarged in Khoi-San women, and may hang down three or four inches below the vagina when women stand, thus giving the impression of a separate and enveloping curtain of skin. Cuvier preserved his skillful dissection of Sartje's genitalia and wrote with a flourish: "I have the honor to present to the Academy the genital organs of this woman prepared in a manner that leaves no doubt about the nature of her *tablier*." And Cuvier's gift still stands forgotten on a shelf at the Musée de l'Homme—right above Broca's brain.

Yet while Cuvier correctly identified the nature of Sartje's *tablier*, he fell into an interesting error, born of the same false association that had been the source of Sartje's fascination—sexuality with animality. Since Cuvier regarded Hottentots as the most bestial of people, and since they had a large *tablier*, he assumed that the *tablier* would become progressively smaller as the darkness of southern Africa ceded to the light of Egypt. (In the last part of his monograph, Cuvier argues that the ancient Egyptians must have been fully Caucasian; who else could have built the pyramids?)

Cuvier knew that female circumcision was widely practiced in Ethiopia. He assumed that the *tablier* was at least half-sized among these people of intermediate hue and geography; and he further conjectured that its removal was necessary for sexual access, not that circumcision represented a custom born of power and imposed upon girls with genitalia not noticeably different from those of Euro-



WE BELIEVE TELEVISION SHOULD MAKE A LASTING IMPRESSION.

At Gulf Oil Corporation, we believe in the enormous potential of American television. The ability of this remarkable medium to enlighten, stimulate, and challenge the way we think about our world.

In support of our position, we continue to underwrite the National Geographic Specials, soon to begin their eighth season on Public Television. This Emmy and Peabody Award-winning series has become one of the most-watched series in the history of public broadcasting—proof that television can indeed marry critical acclaim with family appeal.

Join us this season for adventure and discovery. Watch for new Specials on the Costa Rican rainforest in January; Australian wildlife in February; the giant panda in March; and the dynamic forces of the earth's geology in April.

We believe these documentaries will offer a caliber of entertainment worth watching. And more importantly, worth remembering.

GULF OIL CORPORATION
NATIONAL GEOGRAPHIC SOCIETY
PUBLIC TELEVISION

PARTNERS · IN · DISCOVERY

© Gulf Oil Corporation · 1982

Announcing the ultimate collection of modern world coinage

COIN SETS OF ALL NATIONS

Official circulating coinage of the nation represented — in mint-fresh condition. Includes all the coins currently in circulation in that nation.

Stamp of the issuing nation—typical of its definitive philatelic issues.

Official date-cancellation and postmarking applied by the post office in the nation that issued the coins and the stamp.

Coin Sets of All Nations
REPUBLIC OF AUSTRIA
5 Schilling
20 Schilling
1 Schilling
10 Groschen
5 Groschen
10 Schilling
50 Groschen
2 Groschen
1 Cent
1 Dollar
25 Cents
10 Rupiah
1 Rupiah
25 Rupiah
5 Rupiah
10 Para
5 Para
1 Cent
5 Pounds
5 Pence
50 Pence
½ Penny
1 Pound
1 Yen
10 Yen
5 Yen
BARBADOS

SUBSCRIPTION APPLICATION

COIN SETS OF ALL NATIONS

The Franklin Mint
Franklin Center, Pennsylvania 19091

Please enter my subscription for Coin Sets of All Nations, consisting of a mint-fresh set of circulating coinage from every nation in the world that regularly mints and issues coins, except where government regulations and restrictions on availability prohibit. Each coin set will be issued in a stamped and date-canceled cachet, officially postmarked in the nation of issue. The cachets will be sent to me at the rate of two per month, and the issue price for each cachet is $13.95.*

I need send no payment now. I will be billed $27.90* in advance for each monthly shipment of two coinage cachets. A set of four hardbound storage cases and specially written reference information will also be provided, at no extra charge.

*Plus my state sales tax and 95¢ per cachet for shipping and handling

Signature____________________
ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE

Please mail by October 31, 1982.

Limit: One collection per person.

Mr.
Mrs.
Miss____________________
PLEASE PRINT CLEARLY

Address____________________

City____________________

State, Zip____________________

© 1982 FM

8

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

FM

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 1 FRANKLIN CENTER, PENNSYLVANIA

POSTAGE WILL BE PAID BY ADDRESSEE

THE FRANKLIN MINT
Franklin Center, Pennsylvania 19063

By arrangement with government officials throughout the world, a complete collection of all the circulating coins — in mint-fresh condition — from every coin-issuing country of the world.

Please mail your application
by October 31, 1982.

Limit of one collection per person.

You have the unprecedented opportunity to acquire a collection of world coinage unlike any that has ever been issued before. A collection of *complete sets* of official monetary coins from the coin-issuing nations of the world—with each set sealed in an individual cachet, date-canceled and postmarked in the country of issue.

This comprehensive collection will provide every member of your family with an intriguing way to learn about countries and peoples in every part of the world—through their official coinages. It will be an enjoyable and enriching experience, and an educational adventure as well. For you will gain a better understanding of each country—while you are building a comprehensive collection of world coins that is certain to become a prized family possession.

Assembled by special arrangement with government officials in more than 100 countries

To put together the Coin Sets of All Nations collection, The Franklin Mint made special arrangements with the central banks or monetary authorities of more than one-hundred coin-issuing nations—and with the individual postal authority of each of those nations. Every country that regularly mints and issues coins will be represented in this collection, except where government regulations or restrictions on availability prohibit.

The result will be a comprehensive and fascinating collection of *mint-fresh* coins that would be extremely difficult to assemble even if you were to travel to every one of the coin-issuing countries of the world—because coins in mint-fresh condition usually are obtainable only for a short period of time after they're struck.

Sealed in specially postmarked cachets

Here are the features that make this collection unique:

- All of the circulating coins from each of the coin-issuing nations will be included in the collection.
- Each coin in every set will be in mint-fresh condition.
- Every coin set will be sealed in its own individual cachet, which has been designed especially for this collection.
- Each cachet will be officially stamped and date-canceled, and will be postmarked in the country that issued the coins.
- The complete collection will be available only by subscription.

Coin Sets of All Nations will not be sold through any coin dealers, stores or even national banks in this country or abroad. The collection can only be acquired directly from The Franklin Mint and solely by subscription.

Educational and enjoyable for every member of the family

Many of the coins in this series are outstanding for their beauty, their historical significance and the themes they represent. Thus the collection provides a pleasurable learning experience for young and old alike. The coinage of Greece, for example, evokes its rich classical heritage: the 20 drachmai portraying the great statesman Pericles and the 10 drachmai, the philosopher Democritus. The coinage of Japan features the 100 yen coin with its lovely design of cherry blossoms and the 10 yen with its portrayal of the Byodo-in Temple near Kyoto, capital of ancient Japan.

The coinage of Austria consists of 8 different coins, with the 5 schilling piece showing a Lippizaner stallion of the renowned Spanish Riding School in Vienna. Each coin in Australia's issue portrays a different native animal: the kangaroo, emu, platypus, lyrebird, spiny anteater. The coins of Indonesia depict the exotic birds of that land, and the coins of Fiji ceremonial objects unique to the culture of this island people. By contrast, the coinage of Sweden is very formal: the 1 Krona bearing a classic portrait of King Carl Gustaf and the 50 Ore featuring the royal monogram and the Swedish Crown. More than 100 complete sets in all—each one an education in itself.

These official coinage sets form a collection of infinite variety—and include coins of many different shapes: round, octagonal, twelve-sided, scalloped. And they are minted in a variety of metals: bronze, copper, brass, nickel and cupro-nickel.

Storage cases and reference folders provided

To enable you to store and protect your coinage cachets—and locate the issues quickly and easily—a set of four handsome hardbound cases will be included as part of the collection. In addition, a specially written folder will be sent with each coinage set. It will give important facts about the country represented and background information on its coinage—information you won't find in most books or magazines.

As a subscriber, you will receive your collection at the rate of two issues per month. The price for each issue is $13.95 including the mint-fresh coins, cachets, stamp, foreign postmarking and all customs charges. There is *no added charge* for the storage cases or reference folders.

Subscription applications for Coin Sets of All Nations are being accepted at this time. But because of the difficulty of obtaining a sufficient quantity of *mint-fresh* coins for every nation represented, it is important that your application be mailed promptly. (A future opportunity to subscribe may be offered but cannot be guaranteed.)

To subscribe for this complete series of coinage sets from around the world—and to bring your family a fascinating and educational experience that will enrich their lives—be sure to mail the accompanying postpaid application to The Franklin Mint, Franklin Center, PA, by October 31st.

Coins in special date-canceled cachets, shown smaller than actual size.

© 1982 FM

L.L.Bean®
Outdoor Sporting Specialties

L.L.Bean®
Christmas
1982

Bean's Trail Model Vest

Filled with about 5 ounces of high quality goose down. Goose down breathes for comfort and is the lightest, most efficient insulation available. Shell fabric of wind resistant, water repellent, high thread count nylon taffeta. Snap front closure, down filled collar and kidney warmer back. Length about 27½". Men's vest has self closing pockets, women's has slash handwarmer pockets.

Men's Regular sizes: Sm (34-36), Med (38-40), Lg (42-44), XLg (46-48), XXLg (50).
1419K Men's Regular Trail Model Vest, postpaid.

Men's Long Sizes: Med (38-40), Lg (42-44), XLg (46-48)
1424K Men's Long Trail Model Vest, postpaid.

Boat and Tote™ Bags

Handy tote bags for boaters and campers. Sturdily constructed from extra heavy white duck. While the larger size was designed to carry ice, its capacity is very useful in carrying and protecting bulky and odd shaped gear or clothing. The smaller size is excellent for shopping or as a book bag.

Three colors: White with Red trim.
White with Blue trim.
White with Green trim.

Two sizes:
Small 6"x13½"x12" high. Wt. 16 oz.
8711K Small, postpaid.
Large 8"x17"x16" high. Wt. 26 oz.
8712K Large, postpaid.

FREE Christmas Catalog

Features Bean favorites for men, women and children as well as new ideas for practical, functional gifts. Quality apparel and footwear, woodburning products, home furnishings and winter sports equipment. Many items of our own manufacture. All guaranteed 100% satisfactory.

Mail order shopping at Bean's is fast and efficient. Order any time, 24 hours a day, by phone or mail. We ship promptly and pay postage on orders in the United States and its possessions.

☐ **Send FREE Christmas Catalog**

Name__________
Address__________
City__________ State__________ Zip__________

L. L. Bean, Inc., 761 Casco St., Freeport, ME 04033

VACATION...PLANET EARTH

Explore the Earth with Nature Expeditions International on extraordinary wildlife, cultural and wilderness journeys of discovery.

Travel on foot, camel, elephant and yak . . . Observe exotic cultures, tribes and ruins . . . Photograph birds, flowers, whales, lions and mountains.

Stimulate your mind, body and spirit on one of 30 exciting adventure vacations conducted on six continents.

For free brochures and itineraries, write
Nature Expeditions International
599 College Avenue, Dept. N
Palo Alto, CA 94306•(415) 494-6572

pean women. "The negresses of Abyssinia," he wrote, "are inconvenienced to the point of being obliged to destroy these parts by knife and cauterization" (*par le fer et par le feu*, as he wrote in more euphonious French).

Cuvier also told an interesting tale, which needs no comment in repetition:

> The Portuguese Jesuits, who converted the King of Abyssinia and part of his people during the 16th century, felt that they were obliged to proscribe this practice [of female circumcision] since they thought that it was a holdover from the ancient Judaism of that nation. But it happened that Catholic girls could no longer find husbands, because the men could not reconcile themselves to such a disgusting deformity. The College of Propaganda sent a surgeon to verify the fact and, on his report, the reestablishment of the ancient custom was authorized by the Pope.

I needn't burden you with any detailed refutation of the general arguments that made the Hottentot Venus such a sensation. Their obvious ties to a priori prejudice, rather than to Sartje's reality, can only make us wonder what truths we now hold objective and dear will someday be exposed as equally rooted in hope, culture, and personal preference. I do, however, find it amusing that she and her people are, by modern convictions, so singularly and especially unsuited for the role she was forced to play.

If the early nineteenth century cast the Khoi-San peoples as approximations to the lower primates, they now rank among the heroes of modern social movements. Their languages, with complex clicks, were once dismissed as a guttural farrago of beastly sounds. They are now widely admired for their complexity and subtle expression. Cuvier had stigmatized the hunter-gatherer life styles of the traditional San (Bushmen) as the ultimate degradation of a people too stupid and indolent to farm or raise cattle. The same groups have become prototypes of the ecology movement for their understanding, nonexploitative, and balanced approach to natural resources. Of course, as Guenther points out in his article on the Bushman's changing image, our modern accolades may also be unrealistic. Still, if one must be exploited rather than understood, attributions of kindness and heroism sure beat accusations of animality.

Furthermore, while Cuvier's contemporaries sought physical signs of bestiality in Khoi-San anatomy, anthropologists now identify these people as perhaps the most paedomorphic of human groups. Humans have evolved by a general retardation (or slowing up) of developmental rates, leaving our adult bodies rather similar in many respects to the juvenile, but not to the adult, form of our primate ancestors—an evolutionary result called paedomorphosis, or "child shaping." On this criterion, the greater the extent of paedomorphosis, the further away from a simian past (although minor differences among human races do not translate into variations in mental or any other kind of worth). Although Cuvier searched hard to find signs of animality in Sartje's lip movements or in the form of her leg bone, her people are, in general, perhaps the least simian of all humans.

Finally, the major rationale for Sartje's popularity rests on a false premise. She fascinated Europeans because she had enlarged buttocks and genitalia and because she supposedly belonged to the most backward of human groups. It all fit for Cuvier's contemporaries. Advanced humans (read modern Europeans) are refined, modest, and sexually restrained (not to mention hypocritical for advancing such a claim). Animals are overtly and actively sexual, and so betray their primitive character. Thus, Sartje's exaggerated sexual organs are proof of her animality. But the argument is backward. Humans are the most sexually active primates, and humans have the largest sexual organs of our order. In this dubious line of argument a person with larger than average endowment is, if anything, more human.

On all accounts—mode of life, physical appearance, and sexual anatomy—London and Paris should have stood in a giant cage while Sartje watched. Still, Sartje had her posthumous triumphs. Broca inherited not only Cuvier's preparation of her *tablier*, but her skeleton as well. In 1862, he thought he had found a criterion for arranging human races by physical merit. He measured the ratio of radius (lower arm bone) to humerus (upper arm bone), reasoning that higher ratios indicate longer forearms—a traditional feature of apes. He became very hopeful that objective measurement had confirmed his foregone conclusion when blacks averaged .794 and whites .739. But Sartje's skeleton yielded .703 and Broca promptly abandoned his criterion. Had not Cuvier praised the arm of the Hottentot Venus?

Sartje continues her mastery of Mr. Broca today. His brain decomposes in a leaky jar. Her *tablier* stands above, while her well-prepared skeleton gazes up from below. Death, as the good book says, is swallowed up in victory.

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

"We never thought we could afford Greece."

In case you hadn't heard, Greece is a steal. Because the U.S. dollar is now worth 35% more than just two years ago.

A good hotel for two costs $24 a night. Lunch for two, about $6. A wool sweater, around $20. A night at the ancient Greek theatre sets you back $3.50.

Visit beautiful Athens, then cruise the seductive Greek Isles. Or charter a yacht and be master of your own destiny.

No matter where you go, tour packages are a heftier bargain than any time in recent history.

Call your travel agent.

As luck would have it, Europe's most fascinating country is also one of the least expensive.

Greece. The Classic European Vacation

¡Speak Spanish like a diplomat!

What sort of people need to learn a foreign language as quickly and effectively as possible? *Foreign service personnel,* that's who. Members of America's diplomatic corps are assigned to U.S. embassies abroad, where they must be able to converse fluently in every situation.

Now you can learn to speak Spanish just as these diplomatic personnel do—with the Foreign Service Institute's Programmatic Spanish Course. You'll learn Latin American Spanish recorded by native speakers.

The U.S. Department of State has spent thousands of dollars developing this course. It's by far the most effective way to learn Spanish at your own convenience and at your own pace.

The course consists of a series of cassettes and accompanying textbook. Simply follow the spoken and written instructions, listening and repeating. By the end of the course, you'll be learning and speaking entirely in Spanish!

This course turns your cassette player into a "teaching machine." With its unique "programmatic" learning method, you set your own pace — testing yourself, correcting errors, reinforcing accurate responses.

AUDIO-FORUM®

The FSI's Programmatic Spanish Course comes in two volumes, each shipped in a handsome library binder. You may order one or both:

☐ **Volume I: Basic.** 12 cassettes (17 hr.), manual, and 464-p. text, $115.

☐ **Volume II: Intermediate.** 8 cassettes (11½ hr.), manual, and 614-p. text, $98.

(Conn. and N.Y. residents add sales tax)

TO ORDER BY PHONE, PLEASE CALL TOLL-FREE NUMBER: **1-800-243-1234.**

To order by mail, clip this ad and send with your name and address, and a check or money order — or charge to your credit card (AmEx, VISA, MasterCard, Diners) by enclosing card number, expiration date, and your signature.

The Foreign Service Institute's Spanish course is unconditionally guaranteed. Try it for three weeks. If you're not convinced it's the fastest, easiest, most painless way to learn Spanish, return it and we'll refund every penny you paid. Order today!

81 courses in 26 other languages also available. Write us for free catalog. Our 10th year.

Audio-Forum
Suite 914
On-the-Green,
Guilford, CT 06437
(203) 453-9794

Or visit our New York sales office: 145 E. 49th St., New York, N.Y. 10017 (212)753-1783

Sleeping As the World Turns

The Monday morning blues is just another sign that we are ruled by internal timekeepers

by Martin C. Moore-Ede

The tendency for some organisms to be active at night and others during the day would have been apparent to humans in their earliest contemplations of the temporal order of nature. Written observations on the subject go back to the fourth century B.C. when Androsthenes, the traveling scribe on the marches of Alexander the Great, reported that the tamarind tree, known at that time primarily for its laxative fruit, opened its leaves during the day and closed them at night. Other early descriptions of the periodic behavior patterns of plants and animals are scattered throughout the world's literature, most notably Linnaeus's remarkable documentation, in the eighteenth century, of the daily opening and closing times of a multitude of flowers. Linnaeus even devised a "clock" by cultivating, in the appropriate areas of his garden, flowers that predictably opened and closed their petals at different times. By inspecting his garden, Linnaeus could tell the time—a prospect apparently greeted with some concern by the clockmakers of his day!

In these early writings there is no sign that anybody interpreted the observed daily rhythms as anything but a passive response of organisms to a cyclic environment. This apparently reasonable assumption was not tested until Jean Jacques d'Ortous de Mairan, an astronomer by training, conducted a critical experiment in 1729. In a brief communication to the Royal Academy of Sciences in Paris, he reported on his studies of the leaf movements of a "sensitive" heliotropic plant—one that bends or turns in response to light. This plant was probably *Mimosa pudica*, which unfolds its leaves and pedicels during the day and folds them at night. When de Mairan moved the plant to his cellar, where sunlight could not reach it, he found that it still opened its leaves during the day and folded them for the entire night. Thus the persistence of circadian rhythms in the absence of environmental time cues was first demonstrated. De Mairan recognized the broad implications of his findings for plants and animals and even for ailing humans confined in sick rooms where they could not see the regular progression of day and night. Nevertheless, he finished his brief report with the comment that the progress of experimental science was slow, and he did not have the time to explore this phenomenon further.

Many years passed before the significance of de Mairan's findings was appreciated. Internally generated rhythmic behavior, synchronized to the twenty-four-hour period of the earth's rotation, is not just a biological curiosity. The major function of internal clocks (the circadian timing system) is to measure time and thus allow organisms to anticipate the occurrence of environmental events correlated with day–night cycles. The temperature and illumination of the environment, the availability of food, and the activity of predators all vary over the course of the twenty-four-hour day, and an organism's survival often depends on successfully predicting and preparing for such events.

Appreciation of the timekeeping role of circadian rhythms can be traced back to the beginning of this century. In 1910 a Swiss physician, August Forel, reported that as he and his family were taking breakfast on the terrace of his summer home in the Alps, a few worker bees from a hive about 130 yards distant arrived to sample some marmalade on the table. After a few days, he observed that the bees often appeared on the terrace just before breakfast was served, as if they knew it was time for the food to arrive. Finally, finding it impossible to eat outdoors, the family moved indoors, only to notice that for several days afterward the bees continued to arrive at the terrace table exactly at breakfast time. Because they appeared only at that time of day, Forel suggested that the bees might possess a *Zeitgedächtnis*—a memory for time.

That organisms can truly coordinate their behavior with the time of day was demonstrated in 1929 by German scientist Karl von Frisch and his graduate student Ingeborg Beling. Beling's technique was to mark bees individually and then offer them sugar water at an artificial feeding place for several days—always at the same hour. Then one day no food was placed in the dish and the time of arrival of each bee was observed. In almost all cases, the bees arrived at or near the training time. Even conducting such experiments in the constant conditions of a salt mine, 600 feet below the surface of the earth, did not alter the bees' capacity for timekeeping. Evidence that an internal circadian system was responsible was provided by the finding that the bees could be trained only when food was placed at intervals close to twenty-four hours. If food was presented at nineteen-hour or forty-eight-hour intervals, the bees showed no capability for predicting the pattern.

In 1955, Max Renner of the Institute of Zoology in Munich conducted a definitive experiment to test whether bees were sensing something in their environment that the experimenters had missed. He had identical, windowless laboratories constructed in Paris and in New York City. In the French laboratory he trained forty bees to collect sugar water between 8:15 and 10:15 P.M., then transported the bees overnight to the New York laboratory. The next day the bees again arrived at the feeding table at 8:15 to 10:15 P.M., French time. These experiments showed that neither cosmic rays nor any other unscreened environmental cues could be transmitting temporal information to the bees.

The bees' internal circadian timing system enables them to avoid wasting energy in futile visits to flowers that, following a circadian schedule themselves, offer their nectar or pollen only at restricted times of day. Once bees have identified a flower with nectar available at a given time, they can return each day at the appropriate time, whether or not the sun is shining or other temporal cues are present.

Of particular value in studying circadian clocks is the isolation technique originated by de Mairan in his demonstration that circadian rhythms persist even when an organism is isolated from time cues. By taking an organism out of its natural milieu and placing it in a chamber where the levels of light, temperature, food, and sound are kept constant, an experimenter can largely eliminate the influence of environmental factors that ordinarily obscure internal circadian rhythms. Thus the cycles that emerge under these constant conditions reflect more directly the behavior of the internal clock (or clocks) under study.

Beginning in the 1920s Erwin Bünning in Germany laid the foundations for much of our current understanding of the properties of circadian systems. For example, he demonstrated that plants and insects raised in constant conditions display circadian rhythms. These rhythms are "free running," that is, they have a periodicity of close to, but not exactly, twenty-four hours, so that in the absence of time cues from the environment they gradually deviate from solar time. By crossing strains of plants with different internal periods, he went on to show that the free-running period is genetically inherited. Bünning was the first to recognize that circadian clocks also enable organisms to detect seasonal changes in day length, and he pointed out the evolutionary advantages of this ability. For example, an animal attuned to day length can start getting ready for reproduction in advance of the long days of summer. A large number of investigators have since extensively documented the properties of circadian clocks and demonstrated their ubiquity in organisms ranging from single-celled algae to humans.

Since the 1950s Colin Pittendrigh, first at Princeton and then at Stanford University, has done much to convince biologists of the importance of circadian clocks. In 1954 he published the first of a series of elegant papers demonstrating that the time of day that the fruit fly (*Drosophila*) emerges from its pupal casing is controlled by a circadian clock that is little influenced by variations in environmental temperature. Although most metabolic processes speed up considerably with increases in body temperature, the period of circadian clocks does not. This independence is essential if a circadian clock is to be an effective timekeeping device. Pittendrigh's work also demonstrated that circadian rhythms are not learned phenomena, as Beling and her associates had implied by their use of the word *Zeitgedächtnis*. *Drosophila* pupae raised in constant conditions did not need to be exposed to a twenty-four-hour light–dark cycle to show a circadian rhythm: a single brief flash of light once in the organism's lifetime was all that was necessary to trigger it. Furthermore, separate strains of the flies could be bred, each with distinct rhythmic properties.

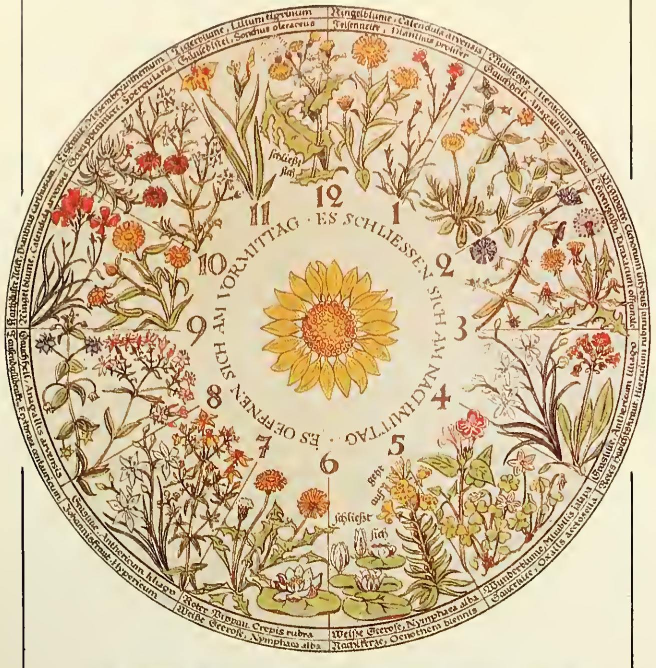
Despite the growing evidence of the internal nature of the circadian timekeeping processes, some researchers still believed circadian rhythms might be the product of undiscovered environmental

TRUTH
Liberty
EQUALITY
Beauty
JUSTICE
Goodness

"Six Great Ideas": Philosopher Mortimer Adler and journalist Bill Moyers join together to explore the greatest concepts in Western Civilization. And why they are important today.
Made possible by a grant from Atlantic Richfield Company, and filmed at the Aspen Institute in Aspen, Colorado. Check your PBS television listings.
ARCO
Atlantic Richfield Company

e Blumen Uhr, by Ursula Schleicher-Benz Jan Thorbecke, publisher, Sigmaringen. Calligraphy in English by Kay Danzig

A Flower Clock


12
1
2
3
4
5
6
7
8
9
10
11
ES SCHLIESSEN SICH AM NACHMITTAG · ES OEFFNEN SICH AM VORMITTAG ·
schließt sich
geht auf
schließt sich

...as devised in 1745 by Linnaeus, "so that even in overcast weather, out in an open field, a person would be able to tell the time as precisely as if he had a clock with him."

An artist's diagram of a clock, published in Germany, depicts the flowers Linnaeus suggested could be used to tell time. On the left-hand side, representing the hours from 6:00 A.M. to noon, are flowers that open in the morning (except for one, the common sowthistle, which closes). At right are shown flowers that close during the afternoon, between noon and 6:00 P.M. (except evening primrose, which opens). Two plants are illustrated for each hour and identified in the border by their names in German and (sometimes outdated) Latin. Starting at six and going clockwise, the common English names of the morning plants are: pink hawksbeard, white water lily; Saint Bernard's lily, Saint Johnswort; scarlet pimpernel, centaury; carthusian pink, field marigold; ice plant, spurry; tiger lily, common sowthistle. The afternoon flowers are: field marigold, Childing pink; mouse-ear hawkweed, scarlet pimpernel; chicory, common dandelion; Saint Bernard's lily, red hawkweed; four-o'clock, European wood sorrel; white water lily, evening primrose.

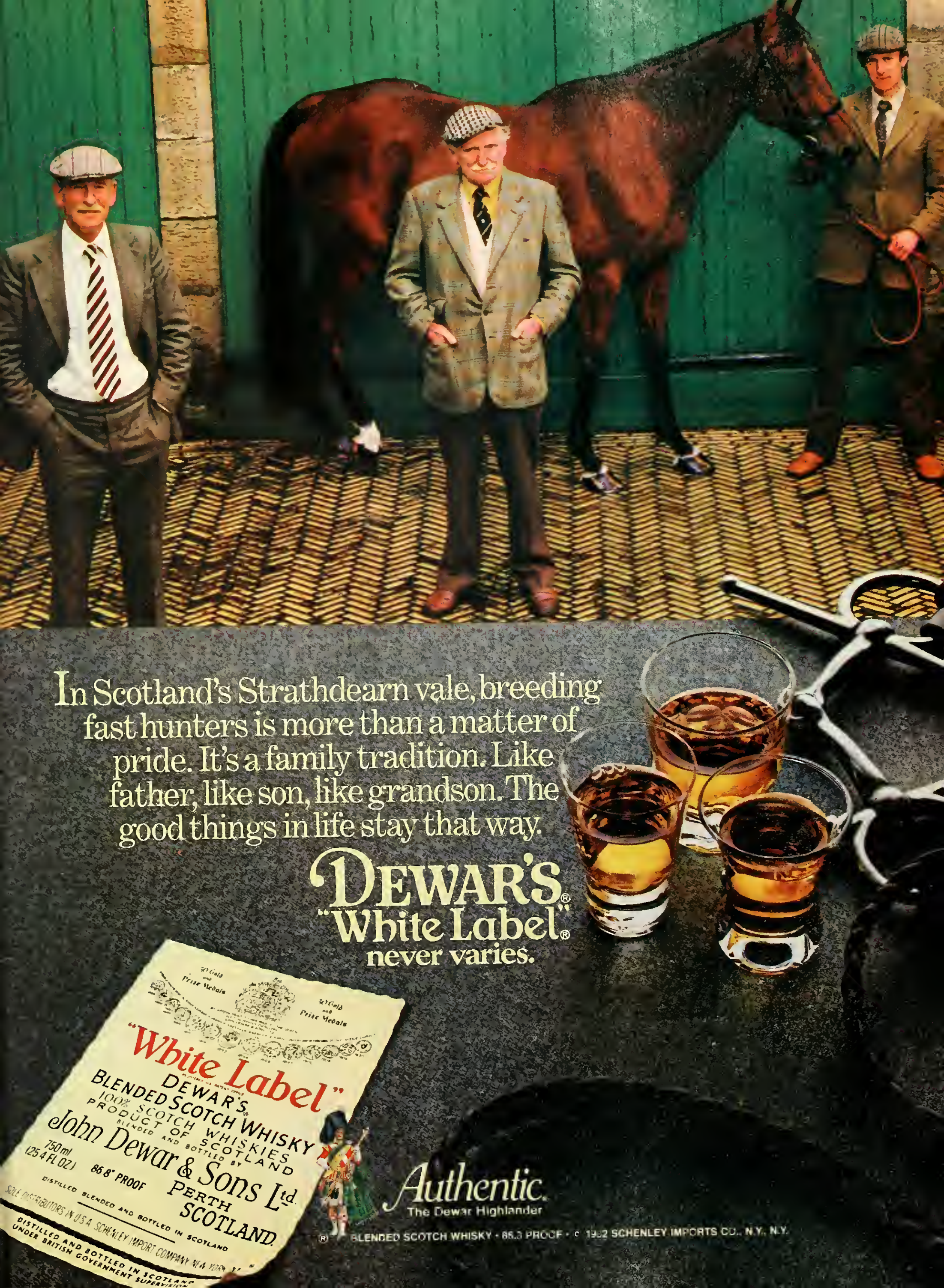
oscillations. Frank Brown, emeritus professor of biology at Northwestern University, has been one of the last proponents of this concept. He has demonstrated that organisms are responsive to weak electromagnetic fields in their environment. Although he has shown that such fields could potentially transmit circadian information, he has not proved that they actually do so.

A number of studies have attempted to rule out the effects of unrecognized cues that might be produced by the earth's rotation. For example, in an experiment conducted at the South Pole, Karl Hamner, a botanist at UCLA, showed that circadian rhythms in hamsters, fruit flies, and *Neurospora* (a fungus with a prominent circadian rhythm of spore growth) persisted even when these organisms were placed on a table that rotated counter to the earth's rotation. Nevertheless, skeptics could still argue that some unrecognized twenty-four-hour cue could be operating. For example, the electrical generator for the South Pole station might be on a twenty-four-hour timer and hence create periodic electromagnetic fields. An obvious environment in which to settle this question is outer space, where organisms can be isolated from twenty-four-hour cues. Up to now, however, animals on space missions (such as the monkey on NASA's Biosatellite III) have been maintained on a twenty-four-hour light–dark cycle in the capsule. In conjunction with two other researchers—Frank Sulzman and Charles Fuller—I plan to put claims about environmental cues to the test next year using NASA's space shuttle. We will send up tubes containing *Neurospora*, keeping them in constant conditions well away from the earth's daily rhythms.

Apart from such isolation experiments, extensive data show a genetic basis for circadian rhythms. Using X-rays or chemicals, mutant organisms with a wide range of periods can be produced. Furthermore, each species has a characteristic free-running period and each individual within a species has its own unique periodicity. The accumulating evidence is rendering untenable the theory that circadian rhythms are externally determined.

It is only twenty years since the first de Mairan-type experiments were conducted with humans. In the early 1960s, Jürgen Aschoff and Rütger Wever built a windowless apartment in the basement of a Munich hospital; it had no clocks, no access to radio or TV, and no other cues relating to the time of day. The subjects had no contacts with the experimenters and they ate their meals and slept whenever they wished. At the same time, an independent experiment was being conducted by a French group headed by Michel Siffre, director of the French Institute of Speleology in Nice. Siffre lived alone in an underground cavern in the French Alps. Deep within the mountain, with no natural light, he too was isolated from the external world and had no knowledge of the time of day.

In both these experiments, human circadian rhythms were shown to have a periodicity somewhat longer than twenty-four hours, typically about twenty-five. Hence, the peaks and troughs of the subjects' rhythms shifted one hour later each day so that, over the course of three or four weeks, the time of sleep progressed all the way around the clock and they lost an entire day. On reentry into the regular world, subjects were surprised to find that it was


"White Label"
DEWAR'S
BLENDED SCOTCH WHISKY
100% SCOTCH WHISKIES
PRODUCT OF SCOTLAND
BLENDED AND BOTTLED BY
John Dewar & Sons Ltd.
PERTH
SCOTLAND
750 ml
(25.4 FL OZ)
86.8° PROOF
DISTILLED BLENDED AND BOTTLED IN SCOTLAND
SOLE DISTRIBUTORS IN U.S.A. SCHENLEY IMPORT COMPANY NEW YORK
DISTILLED AND BOTTLED IN SCOTLAND
UNDER BRITISH GOVERNMENT SUPERVISION
Gold and Prize Medals
Gold and Prize Medals

In Scotland's Strathdearn vale, breeding fast hunters is more than a matter of pride. It's a family tradition. Like father, like son, like grandson. The good things in life stay that way.

DEWAR'S®
"White Label"®
never varies.

Authentic.
The Dewar Highlander

® BLENDED SCOTCH WHISKY • 86.8 PROOF • © 1982 SCHENLEY IMPORTS CO., N.Y., N.Y.

Friday, not Thursday, or Monday, not Sunday.

The tendency for the human sleep–wake cycle to drift later each day by about an hour is a matter of common experience. During weekends, freed from the tyranny of alarm clocks or school or work schedules, most of us stay up later and sleep later. The result is that by Monday morning, our internal circadian systems have shifted two or three hours out of sync with solar time. Hence, when we get up on Monday morning at 7:00 and feel terrible, our body time may actually be 4:00 A.M.—thus accounting for the Monday morning blues.

Shortly after initiating the pioneering studies in Munich, Jürgen Aschoff was appointed director of the Max Planck Institute for Behavioral Physiology, located in Erling-Andechs, a delightful village in the foothills of the Bavarian Alps. With Rütger Wever, Aschoff constructed an elaborate two-apartment isolation facility in an underground bunker built into a hillside. The bunker contained electromagnetic screening to prevent any influence of periodic environmental electromagnetic radiation. Double-compartment doors with locks were built through which food and other materials could be passed without the experimenter and subject ever seeing each other. Each bunker was equipped with its own kitchen and bathroom, enabling volunteers to live independently for weeks on end. Since the 1960s, more than 200 subjects have been studied in this facility, either alone or in small groups, typically for periods of three to four weeks. In each case, free-running circadian rhythms have been observed in a host of physiological and behavioral functions, including rest and activity, body temperature, plasma hormone levels, reaction time, vigilance, and mental computation skill. Each rhythm reaches a peak at one characteristic time of day and a trough at another.

One of the most important findings to come out of this facility is that the circadian rhythms of activity and body temperature can on occasion run independently of each other. For example, a subject might spontaneously adopt a thirty-three-hour rest–activity cycle, perhaps sleeping for thirteen hours at a stretch and being awake for twenty hours, but at the same time his body temperature rhythm would keep a periodicity close to twenty-five hours. Not only does each rhythm deviate from solar time but the rhythms also deviate from each other. The only possible explanation is that at least two separate clocks exist in the human circadian timing system.

To study these phenomena in more detail, and to understand more about the control of sleep and the implications for clinical medicine, Charles Czeisler, Elliot Weitzman, Richard Kronauer, and I established a human isolation facility on the top floor of Montefiore Hospital in New York City. Windows were boarded up and clocks, radios, and TVs were removed, creating apartments similar to those built by the German investigators. However, we did not make elaborate arrangements to exclude noise from aircraft or from street traffic or to exclude electromagnetic radiation.

As we suspected, the human subjects in this facility showed free-running periods of approximately twenty-five hours, similar to those reported from the underground caves of the French investigators and the shielded bunkers of the Germans. Our subjects, who have ranged from twenty to seventy years of age, have lived by themselves in this facility for up to six months at a time. They could choose the time of going to bed and of arising, as well as when they wanted to eat. They were not isolated from contact with the experimenters and technicians, however. The technicians, whenever entering the apartment, would take care to remove their watches, to be freshly shaved (if a man), and to provide no clues or indications of the time of day or even which day it was. When greeted with "Good morning," they were trained to respond accordingly. The subjects could order their breakfast, lunch, or dinner whenever they wished. It would be prepared outside and brought in whether it was 10:00 P.M. for breakfast or 5:00 A.M. for lunch. To avoid the subject's deducing the time of day by which technician was on duty, we randomly computed the schedules so that no technician's shift was consistent either in duration or time of day.

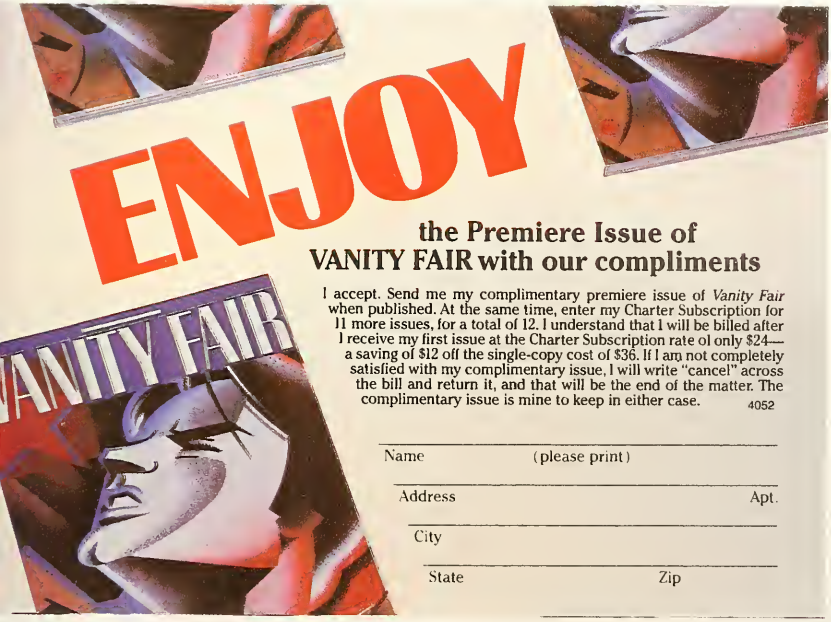
As the German group had seen, internal desynchronization of the sleep–wake cycle and the body temperature rhythm occurred in a number of our first subjects, who spent just one month in temporal isolation. When subjects remained in the facility longer (up to six months), virtually *all* eventually showed internal desynchronization. This suggests that whatever coupling there might be between the two clocks, it is not sufficient to maintain internal synchrony for extended periods of time in the absence of a periodic environment.

From our study of internally desynchronized subjects, we learned that it was the point in the body temperature rhythm when the subjects went to bed that determined the duration of sleep. Subjects who went to bed as their body temperature was falling (as we do in the normal world) would sleep for seven or eight hours. If subjects went to bed when their body temperature was at its maximum, however, they would sleep for fourteen or sixteen hours. This relationship remains true even in the outside world, provided that one has been awake for a regular day length of at least fourteen hours. People who have been on a regular schedule of sleeping from eleven at night to seven in the morning and then stay up for most of the night will only sleep for a few hours if they go to bed at 5:00 A.M., when body temperature is low. However, if they stay up until midafternoon, they will then be able to sleep continuously for sixteen hours or so until the next morning, barring outside disturbances.

The effect of the circadian clocks on sleep patterns is extremely powerful: the length of time you will sleep is not determined by how long you have been awake. In 1966, a seventeen-year-old boy in San Diego, attempting to set a record, stayed awake for eleven days and nights (264 hours). When he finally went to bed he only slept fourteen hours (which was determined by the circadian time he chose to go to bed), and he slept eight hours a night thereafter.

Our circadian rhythms of sleep and wakefulness evolved in synchrony with the regular day–night cycles of our rotating planet. Only in the last few decades, a mere instant on the evolutionary time scale, have the jet plane and the availability of services around the clock dislodged us from the temporal niche in which we evolved (see *Natural History*, September 1982). After traveling across multiple time zones or rotating between day, evening, and night shifts at an industrial plant, a person's body time will be out of sync with the schedule of the outside world. It takes several days before circadian rhythms can readjust to a new environmental time.

Both animal and human studies have enabled us to understand why it takes so long for people to adjust after changing time zones. Circadian clocks can only be shifted from their twenty-five-hour periodicity by an hour or two each day in either direction. This range safely encompasses the normal period of the earth's rotation, but it provides little additional margin for shifting, especially in the advance (eastward) direction. Adjustment on average is faster in a westward direction (delaying one's circadian rhythms with respect to environmental time) because this represents less deviation from the internal twenty-five-hour cycle (recall



ENJOY

the Premiere Issue of VANITY FAIR with our compliments

I accept. Send me my complimentary premiere issue of *Vanity Fair* when published. At the same time, enter my Charter Subscription for 11 more issues, for a total of 12. I understand that I will be billed after I receive my first issue at the Charter Subscription rate of only $24—a saving of $12 off the single-copy cost of $36. If I am not completely satisfied with my complimentary issue, I will write "cancel" across the bill and return it, and that will be the end of the matter. The complimentary issue is mine to keep in either case. 4052

Name (please print)

Address Apt.

City

State Zip

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 365 BOULDER, COLORADO

POSTAGE WILL BE PAID BY ADDRESSEE

VANITY FAIR
P.O. Box 5228
Boulder, Colorado 80321

Announcing the return of a legendary magazine.

VANITY FAIR

Please accept the premiere issue with our compliments

From 1914 to 1936, a most memorable magazine called *Vanity Fair* epitomized the elegance and style, artistry and wit of a now-vanished age.

In March of 1983, Condé Nast Publications will present the premiere issue of the new *Vanity Fair.* A magazine that captures the sparkle and excitement of the '80s as no other magazine today.

Literary and liberated. Adventurous, skeptical, irreverent. As complex and contradictory as the time in which we live. A magazine of literature and the arts. Politics and popular culture. Private lives and public events. Films and theater. Music and dance. Art and photography. TV and travel. Books and economics. Poetry. Food. Sports. Just about everything worth doing, seeing, talking about, knowing about.

Our contributors will include some of today's most original novelists, journalists, poets, artists, photographers, critics. We will offer them a unique freedom and breadth of expression. They, in turn, will offer us their wit, new perceptions, provocative points of view. From its essays, reviews and profiles to its photography, paintings and cartoons, the new *Vanity Fair* will be a magazine of excellence and innovation. A magazine whose time has come… again.

Now, for a limited time, you can reserve a complimentary premiere issue.

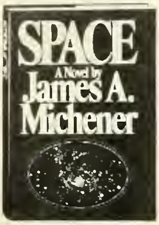
© The Condé Nast Publications Inc. 1982

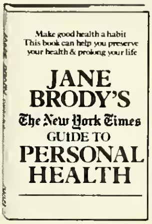
VANITY FAIR

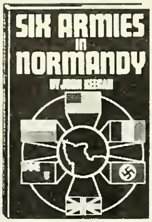
Either.

Choose any 4 books below for two dollars as your introduction to membership in the Book-of-the-Month Club.

You simply agree to buy 4 books within the next two years.

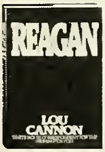

SPACE
A Novel by
James A. Michener
068 Pub price **$17.95**

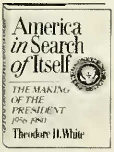

Make good health a habit
This book can help you preserve your health & prolong your life
JANE BRODY'S
The New York Times
GUIDE TO
PERSONAL HEALTH
156 Pub price **$19.95**


SIX ARMIES IN NORMANDY
BY JOHN KEEGAN
741 Pub price **$17.95**

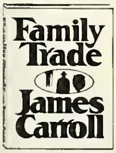
MARSHALL
LEONARD MOSLEY
802 Pub price **$18**

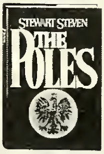
STEPHEN KING
DIFFERENT SEASONS
766 Pub price **$16.95**

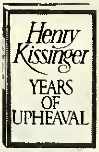

REAGAN
LOU CANNON
720 Pub Price **$17.95**

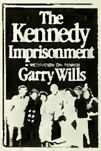

America in Search of Itself
THE MAKING OF THE PRESIDENT 1956-1980
Theodore H. White
445 Pub price **$15.95**

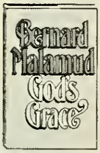
The New York Times
COOK BOOK
by Craig Claiborne
244 Pub price **$16.95**

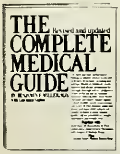

Family Trade
James Carroll
072 Pub price **$14.95**

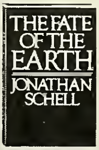

STEWART STEVEN
THE POLES
804 Pub price **$15.95**


Henry Kissinger
YEARS OF UPHEAVAL
089 Pub price **$24.95**

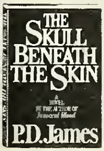

The Kennedy Imprisonment
Garry Wills
559 Pub price **$14.95**


Bernard Malamud
God's Grace
801 Pub price **$13.50**

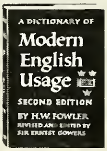

THE COMPLETE MEDICAL GUIDE
Revised and updated
722 Pub price **$19.95**

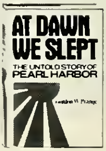

THE FATE OF THE EARTH
JONATHAN SCHELL
444 Pub price **$11.95**

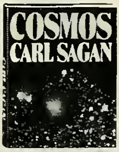
667 Pub price **$14.95**
(Softcover)


THE SKULL BENEATH THE SKIN
P.D. James
388 Pub price **$13.95**

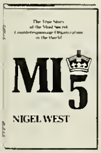
MANTISSA
JOHN FOWLES
267 Pub price **$13.95**

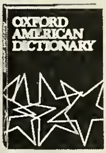

A DICTIONARY OF
Modern English Usage
SECOND EDITION
BY H.W. FOWLER
REVISED AND EDITED BY SIR ERNEST GOWERS
565 Pub price **$15**

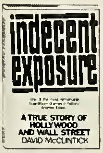

AT DAWN WE SLEPT
THE UNTOLD STORY OF PEARL HARBOR
046 Pub price **$22.95**


COSMOS
CARL SAGAN
526 Pub price **$22.95**

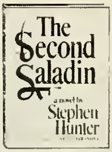
Helen MacInnes
CLOAK OF DARKNESS
023 Pub price **$13.95**

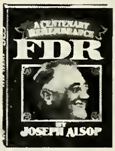

MI 5
NIGEL WEST
803 Pub price **$16.95**


OXFORD AMERICAN DICTIONARY
624 Pub price **$14.95**


indecent exposure
A TRUE STORY OF HOLLYWOOD AND WALL STREET
DAVID McCLINTICK
806 Pub price **$17.50**

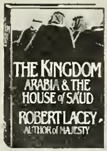
DAVID ATTENBOROUGH
Life on Earth
439 Pub price **$22.50**

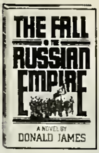

The Second Saladin
a novel by
Stephen Hunter
442 Pub price **$14.50**


A CENTENARY REMEMBRANCE
FDR
BY JOSEPH ALSOP
786 Pub price **$25**

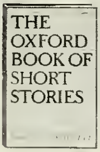
MYSTERIES OF THE PAST
740 Pub price **$34.95**

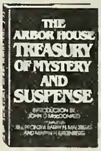
271 Pub price **$16.95**


THE KINGDOM
ARABIA & THE HOUSE of SAUD
ROBERT LACEY
AUTHOR of MAJESTY
372 Pub price **$19.95**


THE FALL OF THE RUSSIAN EMPIRE
A NOVEL BY
DONALD JAMES
800 Pub price **$13.95**

Second Heaven
Judith Guest
781 Pub price **$14.95**


THE OXFORD BOOK OF SHORT STORIES
242 Pub price **$19.95**


THE ARBOR HOUSE TREASURY OF MYSTERY AND SUSPENSE
256 Pub price **$20.95**

Benefits of Membership

Membership in the Book-of-the-Month Club begins with your choice of either 4 of today's best books for $2 or one of the extraordinary works offered here. Because our prices are generally lower than the publisher's price, you will save on works such as these throughout your membership. In fact, the longer you remain a member, the greater your savings can be. Our Book-Dividend® plan, for which you become eligible after a brief trial enrollment, offers savings from 50% to 75% off the publisher's price on art books, reference works, classics, books on cooking and crafts, literary sets and other contemporary works of enduring value. Nevertheless, all Book-of-the-Month Club books are equal in quality to the publishers' originals; they are not condensed versions or cheaply made reprints.

- As a member you will receive the *Book-of-the-Month Club News®* 15 times a year (about every 3½ weeks). Every issue reviews a Selection and 150 other books that we call Alternates, which are carefully chosen by our editors.
- If you want the Selection, do nothing. It will be shipped to you automatically. If you want one or more Alternates—or no book at all—indicate your decision on the Reply Form and return it by the specified date.
- *Return Privilege*: If the *News* is delayed and you receive the Selection without having had 10 days to notify us, you may return it for credit at our expense.
- *Cancellations*: Membership may be discontinued, either by you or by the Club, at any time after you have bought 4 additional books.
- Join today. With savings and choices like these, no wonder Book-of-the-Month Club is America's Bookstore®

Or.

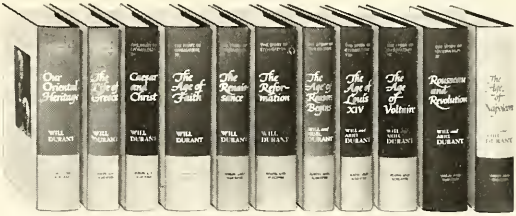
Choose one of the 5 valuable sets below as your introduction to membership in the Book-of-the-Month Club.

You simply agree to buy 4 books within the next two years.

The Compact Edition of The Oxford English Dictionary

for **$24.95** (Publisher's price $125)

The "most complete, most scholarly dictionary of the English language"–*The Christian Science Monitor.* Through photo-reduction, the original 13-volume set has been reproduced in this two-volume *Compact Edition.* Magnifying glass included.



The Story of Civilization by Will and Ariel Durant

for **$29.95** (Publisher's prices total $307.45)

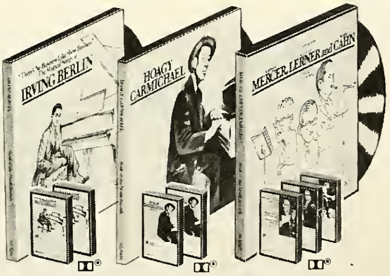
For almost half a century Will and Ariel Durant traced the continuity of world history to show the foundations of society today. The Durants' 11-volume illustrated masterwork is history come alive in all its dimensions. The enormous scope of the work covers ancient and recent civilization, including Oriental as well as Western history. A Book-of-the-Month Club exclusive for close to 50 years, it is both a reference work of undisputed authority and a lively portrait of the rulers and leaders who have shaped the course of human events.

The Encyclopedia of Philosophy
1-2
3-4
5-6
7-8

The Encyclopedia of Philosophy

for **$24.95** (Publisher's price $150)

The most comprehensive encyclopedia of philosophy ever published, this set traces ancient, medieval, modern, Eastern and Western thought. An essential and rewarding reference source for home libraries.



Great American Songwriters

for **$14.95** (Nonmember's prices total $74.85)

The best of American musical theater and popular music in one unique collection. The genius of Irving Berlin, Hoagy Carmichael and Johnny Mercer, Alan Jay Lerner, Sammy Cahn. In ten records, seven cassettes or seven 8-tracks.

Wildlife Habitat Series

for **$19.95,** 6 Vols.
(Pub prices total $113.70)

Six volumes from the award-winning series: wildlife of the polar regions, forests, islands, prairies and plains, rivers and deserts. More than 200 color photographs in each volume, along with maps, appendix and detailed glossary.

Book-of-the-Month Club, Inc., Camp Hill, Pennsylvania 17012 A113-10

Please enroll me as a member of Book-of-the Month Club and send me *either* the four books I've listed in the "Either" boxes at right, billing me $2, plus shipping and handling charges, *or* the one set I've checked in the "Or" column, billing me for the appropriate amount, plus shipping and handling charges. In either case, I agree to buy four additional books from the Club over the next two years. A shipping and handling charge is added to each shipment.

Mr.
Mrs.____________________
Miss (Please print plainly)

Address____________________ Apt_____

City____________________

State____________________ Zip_____

Prices shown are U.S. prices. Outside the U.S., prices are generally higher.

BOOK-OF-THE-MONTH CLUB®
America's Bookstore since 1926.

Either.
Indicate by number the four books you want

☐
☐
☐
☐

2-04

Or.
Check one box only

☐ 912. Compact OED **$24.95**
☐ 913. The Story of Civ. **$29.95**
☐ 917. Ency. of Philosophy **$24.95**
☐ 947. Wildlife Series **$19.95**
☐ 948. Great American Songwriters (10 Records) **$14.95**
☐ 949. Great American Songwriters (7 8-Track Tapes) **$14.95**
☐ 950. Great American Songwriters (7 Cassettes) **$14.95**

2-64

"Shiningly intense
...Jean Auel's graceful prose and sheer storytelling skill hold the reader in a powerful spell." —*Publishers Weekly*

THE VALLEY OF HORSES
EARTH'S CHILDREN™
by JEAN AUEL
author of *The Clan of the Cave Bear*
A Literary Guild Alternate.
$15.95, now at your bookstore

CROWN

This publication is available in microform.

University Microfilms International

300 North Zeeb Road
Dept. P.R.
Ann Arbor, Mi. 48106
U.S.A.

30-32 Mortimer Street
Dept. P.R.
London W1N 7RA
England

that subjects in isolation experiments lengthen each day by about an hour without even realizing it). Klein and his colleagues in West Germany have shown that in a westbound trip across six time zones, a person's rhythms of psychomotor performance take four days to adjust, whereas the same rhythms take an average of eight to ten days to resynchronize after eastbound flights. (Because there is more than one clock, some rhythms take longer to adjust than others, and so the time for full readjustment of the circadian system may be even longer after such travel.)

Because of the limits to resetting circadian clocks it is not possible to live on an eighteen-hour or a thirty-hour day–night cycle and keep the entire circadian system in step. Yet such schedules are in use today. The Stockholm police work a shift system that starts four hours earlier each day and, hence, live on a twenty-hour day–night schedule. Similarly, the crews of the atomic submarines of the U.S. Navy, which cruise under the ocean for a couple of months at a stretch, are maintained on an eighteen-hour day–night cycle, operating three shifts of only six hours in length. Crew members have twelve hours off duty between work shifts, including six hours' sleep time. Although there is some choice in scheduling the sleep time, individuals on such naval watch schedules have considerable problems with insomnia, emotional disturbance, and impaired coordination, and their sleep is highly fragmented compared with that of personnel on shore-based installations. Perhaps the best indicator of the difficulty is the high turnover of enlisted men in U.S. submarine crews—as high as 33 to 50 percent per voyage—and the small number of men who undertake more than two or three of the ninety-day submarine missions. There would be considerable advantage to adopting a twenty-four-hour work–rest schedule for the whole crew, not just for the officers as is the current practice. In this way, the men could function optimally and the dropout rate might be lower.

As I discussed in my previous article, among the major issues for the twentieth-century work force is the problem of staffing critical industrial, security, and emergency services around the clock. The information now available on the circadian timing system permits the design of shift-work schedules so that they least disrupt workers' internal rhythms. A number of different approaches have been used. The first, and perhaps the most obvious, is to place workers on straight shifts so they do not rotate their time of duty. However, staffing the night shift is often difficult and even when on the night shift, workers usually revert to daytime activity on their weekends or days off. Another strategy, particularly favored in Europe, is to place workers on rapidly rotating schedules whereby they stay on any one shift for only one or two days at a time. In this way, it is reasoned, workers will not have time to adapt to a new sleep cycle, but instead will continue their usual twenty-four-hour periodicity. Of course, workers who draw the night shift may have a significant dip in performance between 3:00 and 5:00 A.M.

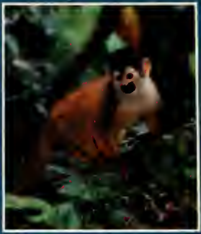
Alan Reinberg in France has pioneered another strategy that takes account of individual differences in the ability to adjust after a shift in sleep and work times. Hiring individuals who are most tolerant of schedule changes can minimize the effects of rotating shift work. But major legal issues arise whenever an employer tries to select workers according to their susceptibility to agents or factors in the workplace. My colleagues Charles Czeisler (Harvard) and Richard Coleman (Stanford) and I favor a fourth approach. Through the Center for Design of Industrial Schedules, a Boston-based nonprofit service organization, we have placed industrial shift workers on schedules that rotate less frequently. In one case, the workers in question had previously changed shifts every week; under the new arrangement, they only changed shifts every three weeks. Thus they had more time to reestablish their sleep and performance rhythms after each change in shift. We also changed the direction of shift rotation so that it conformed to the natural tendency of the sleep–wake cycle to drift to later hours.

Until now most shift-work schedules in industry have been a matter of local practice or industry tradition and have not taken into account biological factors. The new information on the mechanisms of the circadian timing system makes it possible to devise more rational approaches. I am currently chairing an International Scientific Advisory Board that is reviewing and evaluating governmental regulations and health policies in situations where the work schedule may relate to public safety, such as airline pilot schedules. The time has come to solve a problem that affects so many people.

Martin C. Moore-Ede, professor in the Department of Physiology and Biophysics of the Harvard Medical School, is coauthor of The Clocks That Time Us: Physiology of the Circadian Timing System, *published by Harvard University Press.*

COSTA RICA

"THE WILDLIFE SANCTUARY OF THE AMERICAS"



Costa Rica is endowed with more species of birds and mammals than the United States and Canada combined.

A tropical paradise preserved by a renowned National Park System, Costa Rica offers a diversity of fauna and flora creating a haven for nature lovers and is the world center for scientific study of tropical biology.

From the highland cloud forests of the Monteverde Preserve to the coastal tropical lowlands of Corcovado National Park, this peaceful little country abounds with picturesque beauty and exotic wildlife.

1983 Departure Dates

February 11; March 11; April 29; July 1

$998 10 days (all inclusive from Miami)

INTERNATIONAL EXPEDITIONS, INC.

Suite 104 • 1776 Independence Court • Birmingham, Alabama 35216 • (205)870-5550

TOLL FREE
1-800-633-4734

COSTA RICA
EXPEDITIONS

Lacsa
The Airline of Costa Rica

The Bountiful Yeoman

In seventeenth-century New England, the independent family had to be skilled at food preservation

by Jay Anderson

Nathaniel Newbury, a vicar from Kent, noted in a 1652 sermon: "It has always been that at a yeoman's table you might have as good entertainment as at the best Gentlemans, not for variety of messes, but for solid sufficiency and hearty welcome." In search of this good life, thousands of English families crossed the Atlantic in the seventeenth century. Since then, our folklore, literature, and popular culture have nurtured an image of middle-class success brought about by hard work and epitomized by an abundance of simple, satisfying food and generous, informal hospitality. The power of this image is worth considering, especially in colonial New England where it was vigorously tested on the good but hard land.

The majority of colonists were either husbandmen or yeomen, two classes of tough-minded farmers who worked their own land. They were a proud lot, born and raised in small rural villages that they administered in a rough democratic fashion. They valued their independence, especially where food was concerned. In 1621 William Webb observed: "They lay seldom any money for any provision, but have it of their own as Beefe, Mutton, Veal, Pork, Capons, Hens, Wild-Fowl, and Fish. They bake their own bread and brew their own drink." Farmers also prized generosity and skill in preserving food. John Stephens emphasized these attributes in his 1615 portrait of the yeoman:

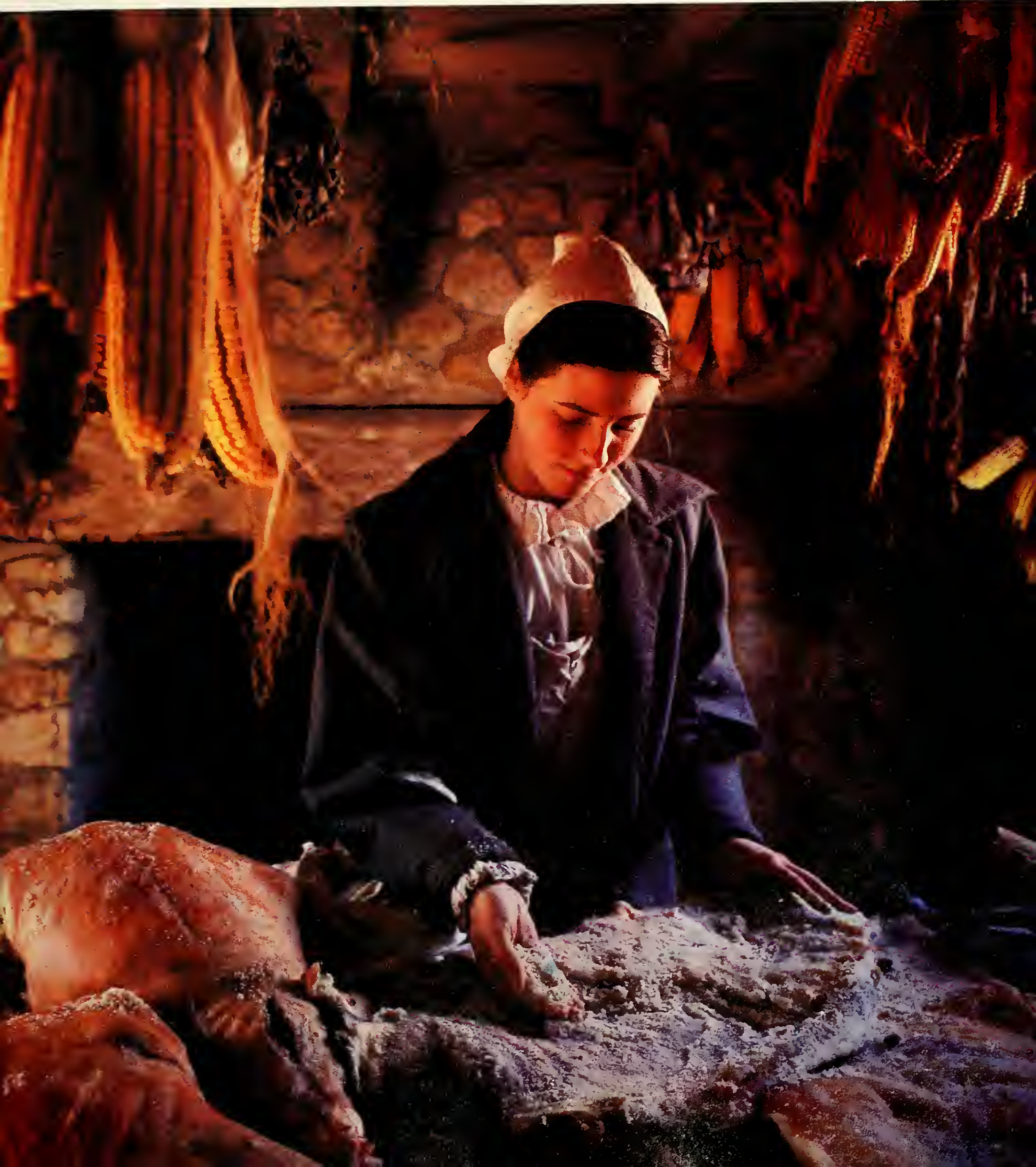
> The pride of his house-keeping is a mess of cream; a pig, or a green goose; and if his servants can uncontrolled find the highway to the cupboard, it wins the name of bountiful yeoman. . . . Meanwhile, he makes the prevention of dearth his title to be thought a good commonwealth's [family] man. And therefore he preserves a chandler's treasure of bacon, links, and puddings in the chimney corner.

Ambitious yeomen, such as Stephens's man, were known as "improvers," and they sought to transplant their rural English culture to the New World—but with improvements: bigger farms, better crops, larger herds of livestock, more security from famine, and a greater opportunity to share hospitality with friends. A line in the

Photographs by Cary Wolinsky

Colonial farm wives dry-salted hams and stored them as part of the family's supply of winter meat. Corn, hanging from the ceiling to dry, became the colonists' "main staffe of life."

All photographs taken at Plimoth Plantation, Plymouth, Massachusetts



Surviving the long New England winter through the careful storage and preservation of surplus food was the focus of activities in late fall in settlements such as Plimoth Plantation, below. A farmer, right, brings in the stalks, or shocks, of corn at harvesting time.

1605 play *Eastward Hoe* captured their dream of America: "There wee shall have no more Law than conscience, and not too much of eyther; serve God enough, eate and drink enough, and enough is as good as a Feast!"

How much was enough? What did a healthy adult eat on a farm near Plimoth, Boston, or Salem in the seventeenth century? The content and amount of a New Englander's diet varied from season to season, but the "minimum daily allowance" an individual would strive for was half a pound of meat, fish, or cheese; a quarter pound of corn, oats, or barley-porridge meal; the same amount of dried peas or beans; a full pound of bread, usually corn mixed with rye flour; fresh or cellared vegetables and fruit; as much butter as possible; and a gallon of strong dark beer. This was the diet someone like John Alden, a hard-working farmer and cooper, would expect.

Farmers ate two substantial meals a day. Fynes Moryson recorded in his 1617 diary that "those that journey and some sickly men staying at home may perhaps take a small breakfast, yet in general the English eat but two meals of dinner and supper each day." Forty years earlier, William Harrison noticed that "husbandmen dine at high noon, as they call it, and sup at seven or eight." Generally, the housewife prepared a hot dish for each meal. Dinner might feature boiled corned beef and cellared vegetables (onions, carrots, cabbage, turnips, and parsnips), bread, butter, and beer. For supper, the housewife might pan-fry a hash of the leftovers. If she added beets, it would become red flannel hash. Good cooking was appreciated, and the yeoman housewife had a rich store of traditional recipes in her repertory. Many of these were collected into cookbooks of the period, such as Gervase Markham's popular *The English Housewife* (1615), which both drew upon and enriched regional folk cookery.

The colonists brought with them as part of their cultural baggage a cuisine that was provincial in the best sense of the word: regional peasant fare that was grown, harvested, preserved, and eaten on the farm, following traditions of agriculture and cookery that had evolved over the centuries. They were aware of the value of this heritage and worked hard to establish it in New England. The first step was to develop farms that would supply a household with its basic food: cereal grains, field legumes, meat, dairy products ("white meats"), garden vegetables, and fruits. They then had to formulate a yearly preservation plan that indicated how surplus foods harvested in seasons of plenty would be processed and stored for later use, especially in late winter and early spring.

In England, a typical yeoman family lived off the land and produced a modest surplus on a "mixed" farm. By deliberately utilizing a mixture of different foods and agricultural methods, the farmer hoped to insure his family's survival if, for example, one particular crop should fail or if he or his wife or another key worker should be injured. These small farms ran about sixty acres in size and were divided into a home lot, the area closely connected to the house, and an outer holding, consisting of arable fields, pastures, meadows, and a wood lot. The home lot was the housewife's responsibility and included a kitchen garden; shelters and pens for small livestock such as poultry, pigs, and goats; a fruit orchard; and an enclosed pas-

ture for the one or two "milch," or dairy, cows. There might also be beehives, rabbit hutches, and a dovecote. The home lot provided many important foods—fresh meat, dairy products, vegetables, fruits, and honey—as well as a food reserve if field crops failed, which they often did. Women were significant producers of food, and Gervase Markham counseled that in times of dearth, the "country housewife must proceed from the privisions of her own yard."

The outer holdings were the responsibility of the farmer, his sons, his male relatives, and laborers. On the arable fields they grew cereal grains and legumes—the proverbial oats, peas, beans, and barleycorn, as well as rye and wheat. In summer, the men cut hay in the pastures and wild grasses from the meadows. Even the wood lot produced food indirectly; its acorns and nuts became mast for goats and pigs. The outer holdings provided the household with the bulk of its diet, and except for the dairymaids' daily sojourn into the pasture and the women who helped with the harvest, this was a male dominion. A successful mixed farm, therefore, was a cooperative effort of husbandman and housewife, with complementing spheres of responsibility.

The colonists' attempts to transplant the English mixed farm and its balanced agricultural system failed in some ways, succeeded in others. The basic bread and porridge crops—wheat, rye, and oats—did poorly at first. Wheat especially had trouble overcoming "the blast," a virulent smut disease. Peas also fared badly during the long hot summers. And barley seldom yielded sufficiently to guarantee a regular supply of beer. Fortunately, fruits and vegetables traveled well, and kitchen gardens and orchards began to fill the nutritional and caloric hole left by the lack of small grains. By the 1650s, cider replaced beer as the daily drink. Apples were simply easier to grow and process than barley, and because of cider's slightly greater alcoholic content, it was more stable during winter. Livestock, especially pigs, also did well in the temperate Northeast. The supply of meat and dairy products steadily increased, to everyone's delight. Later immigrants were amazed at the amount of meat eaten in the American colonies. Tables seemed smothered in corned beef, pickled pork, country hams, and bacon. By and large, these particular changes in the colonists' core diets were welcomed.

The introduction of the Indian triad—corn, beans, and pumpkins—brought about a culinary culture shock. Farmers

Cod was dry-salted on wattle racks. The product was an important preserved food and might end up in a spring or summer chowder.

Pumpkins were one of the Indian crops that became a crucial part of the colonists' diet. The housewife, below, is stringing pieces of pumpkin for drying.

liked corn because it yielded three or four times as many bushels per acre as English grains, and they grudgingly admitted that this Indian "wheat" was the "thing most necessary to sustain man . . . the main staffe of life." But corn, lacking the gluten of wheat, could not provide the flour for the crusty Old World loaves the colonists preferred. Still, cooks experimented, borrowing Indian recipes or using corn as a substitute ingredient in English dishes. John Josselyn, who traveled around New England in the 1630s and returned again in the 1670s, observed the results:

> Indian Wheat, of which there is three sorts, yellow, red, and blew . . . is light of digestion, and the English make a kind of Loblolly [thick gruel or porridge] of it to eat with Milk, which they call Sampe; they beat it in a Morter, and sift the flower out of it: the remainder they call Homminey, which they put into a Pot of two or three Gallons, with Water, and boyl it upon a gentle Fire till it be like a Hasty Pudden; they put of this into Milk, and so eat it. Their Bread also they make of Homminey so boiled, and mix their Flower with it, cast it into a deep Bason in which they form the Loaf, and then turn it out upon the Peel, and presently put it into the Oven before it spreads abroad; the Flower makes excellent Puddens.

Josselyn called these recipes for cornmeal mush and corn bread "New England standing Dish [es]," the term used for everyday staple foods. He also mentions beans ("Indian Beans, falsely called French beans, are better for Physick than our Garden Beans"), but of pumpkins, Josselyn waxed eloquent. With them, colonial farm wives created an "ancient" New England standing dish:

> The Housewives manner is to slice them when ripe, and cut them into dice, and so to fill a pot with them of two or three Gallons, and stew them upon a gentle fire a whole day, and as they sink, they fill again with fresh Pompions, not putting any liquor to them; and when it is stew'd enough, it will look like bak'd apples; this they Dish, putting Butter to it, and a little Vinegar, (with some Spice, as Ginger, &.) which makes it tart like an Apple, and so serve it up to be eaten with Fish or Flesh.

Josselyn does mention two unfortunate side effects of stewed pumpkins: "It provokes Urin extreamly and is very windy." Despite these irritants, Indian crops became crucial elements in the colonial diet. As one wag put it, "We have pumpkins at morning, pumpkins at noon; If it were not for pumpkins, we should be undoon."

By the late seventeenth century, New Englanders had developed a satisfactory version of the old mixed farm by integrating English and Indian crops. They overcame the problem of providing a secure food base, while at the same time, their wives were creating an American folk cuisine with "standing dishes" such as succotash, brown bread, Indian pudding, baked beans, and clam chowder.

Surviving the long New England winter long enough to enjoy this food was the colonists' second problem. To solve it, they had to budget their food annually, preserving summer and autumn's surplus food for use in winter and spring, the periods of dearth. Their goal was a balanced sufficient diet throughout the year, particularly in late winter, the truly perilous time. William Bradford described the situation in Plimoth in February and March of 1621:

> . . . there died some times two or three of a day in the foresaid time, that of 100 and odd persons, scarce fifty remained. And of these, in the time of most distress, there was but six or seven sound persons who to their great commendations, be it spoken, spared no pains night nor day, but with abundance of toil and hazard of their own health, fetched them wood, made them fires, dressed them meat, made their beds, washed their loathsome clothes, clothed and unclothed them. In a word, did all the homely and necessary offices for them which dainty and queasy stomaches cannot endure to hear named.

Weak from hunger and suffering from malnutrition, half of the Pilgrims died from scurvy and other related diseases. This story became legendary, and later colonists were determined to avoid the starving times that beset the first settlers.

Fortunately, they possessed a number of cultural aids to assist them. Centuries of experience fighting poor crops, lack of workers during harvest, unseasonable weather, vermin and pests, and human frailty such as gluttony and laziness had been recorded in their folklore. As peasants, they relied on and respected the accumulated wisdom of their forebears. Much of this practical knowledge was current in oral tradition. In the late sixteenth and early seventeenth centuries, however, writers such as Thomas Tusser began to collect this lore and publish it in farmers' handbooks, often written in an easy-to-read-and-remember style. Tusser used rhyming verse. For example, his advice for October deals with slaughtering:

At Hallontide, slaughter-time
entereth in, and then doth,
the husbandman's feasting begin:
From thence unto Shrovetide,
kill now and then some,
Their offall for household
the better will come.

(For Easter) at Martilmas,
hang up a beef,
for stall-fed and pease-fed,
play pick-purse the thief;
With that and the like,
ere an grass beef come in,
they folk shall cherrly,
when others look thin.

A farm wife stuffs sausage meat into casings. Sausages, or links, along with bacon and puddings, were stored in the chimney corner. A plate of pumpkin slices is in foreground.

Pork sausage, corn bread, and pumpkins were staple items in the diet of seventeenth-century colonists. Corn, an Indian crop, supplanted wheat because it yielded more per acre.

These two modest stanzas remind the farmer of when to slaughter (from Hallontide in late October to Shrovetide in early Lent), what meat to eat fresh (offal such as brains, liver, kidneys, sweetbreads, and so on), when to kill a really large animal such as beef (Martilmas, or Martinmas, November 11), and why (the animal, cooped up in its winter stall, would eat too much expensive fodder such as peas), and what happens because of planning or the lack of it (planning equals cheery folks, neglect equals thin ones).

In his November passage, Tusser talks about chimneys:

The chimney all sooty,
would now be made clean,
for fear of mischances, too oftentimes seen:
Old chimney and sooty, if fier once take,
by burning and brekaing,
some michief may make.

Since farmers preserved their "chandler's treasure of bacon, links, and puddings, in the chimney corner," and their hams higher up in the chimney itself, a fire here could destroy the family's supply of winter meat. In December, Tusser cautions farmers to take care of their dried fish, an important New England staple:

Both salt fish and ling fish (if any ye have),
through shrifting and drying,
from rotting to save,
Lest winter with moistness
do make it relent,
and put it in hazard, before it be spent.

His strongest warnings, however, come in January and apply to the entire year's preservation effort:

From Christmas, till May be well entered in,
some cattle ware faint,
and look poorly and thin:
And chiefly when prime grass
at first doth appear,
then most is the danger of the whole year.

Be greedy in spending, and careless to save,
and shortly be needy, and ready to crave,
Be wilful to kill, and unskilful to store,
and look for no foizon [harvest],
I tell thee before.

In all, Thomas Tusser wrote down "five hundred points of good husbandry" in his 1573 book of the same name. Each point was a tactic in the farmer's struggle for survival, and many deal specifically with the what, how, when, where, and why of food preservation. They are quintessential folk wisdom.

The husbandman and housewife could also draw on traditional knowledge concerning the use of the farmhouse, outbuilding, and small items of material culture in preserving food. Nicholas Breton in 1618 enumerated them:

> Again we have hay in the house, horses in the stable, oxen in the stall, sheepe in the pen, hoggs in the stie, corn in the garner, cheese in the loft, milk in the dairy, creame in the pot, butter in the dish, ale in the tub, aqua vitae in the bottle, beefe in the brine, brawn in the sowce, bacon in the rofe, herbs in the garden, and some money in our cophers, and having all this, if we serve God withal, what in God's name can we desire to have more?

The entire farmstead functioned as a complex pantry in which every type of preserved food was appropriately stored. A family could draw on their knowledge of the "keeping" characteristics of their buildings and grounds, as well as the methods by which fresh foods could best be processed and preserved. For example, cheese is kept in the cool, dry loft, a second-floor room; while bacon is hung even higher in the roof where accumulating smoke will help to dry, coat, and flavor it. Vegetables, or "herbs," are cellared in the garden, cached away in straw-lined, earth-covered pits, and large muscle cuts of beef and pork (brawn) are pickled in different brines. Milk is found in the cool, humid dairy, and two of its byproducts—cream and butter—have been separated and individually laid up. Threshed corn (cereal grain) is in the garner or barn awaiting milling, while the barley has already been preserved—malted and brewed into ale. Even fruit is stored away in bottles as aqua vitae, or brandy. Breton's picture was not a dream. Countrymen used their farmsteads and containers in this way, as probate room-by-room inventories indicate.

All too often trouble still intruded: rats ate the corn, maggots tunneled through the cheese, a wet winter rotted the dried fish, poor dairy work turned the butter rancid, pork or beef spoiled at the bottom of tainted barrels, and even beer oxidized and turned to vinegar. There were traditional remedies for these problems, but drawing up and implementing a preservation plan required hard mental and physical work. Daily life in seventeenth-century New England was anything but simple or easy if the farmer wanted to make "the prevention of dearth his title to

The approaching winter may mean that this pig's days are numbered. Pigs thrived in the temperate Northeast and supplied the colonists with ample quantities of pickled pork, bacon, hams, and sausages.

be thought a good commonwealth's man."

Fortunately, the farmer's rural community and tradition supported him. In addition to a folklore rich in suggestions for advantageously using time, space, and the natural and cultural worlds, the village (or town in New England) also provided social reinforcement in the form of traditional feasts and fasts, culinary events that punctuated the entire annual calendar. Four of these events framed and marked the passage of winter.

Harvest home, an essentially secular feast, was held in autumn when the primary bread crops—wheat, rye, and corn—were ripe. In 1641, Henry Best chronicled in his diary the kind of harvest meal that could have been found on either side of the Atlantic:

> It is usual, in most places, after they get all the pease pulled or the last grain down, to invite all the workfolks and their wives to supper, and then they have puddings, bacon, or boiled beef, flesh or apple pies, and then cream brought in platters, and every one a spoon, then after all they have hot cakes and ale; . . .

Such feasts sometimes lasted up to a week, as was the case in Plimoth in the autumn of 1621. Edward Winslow, in a letter to a friend in England, recounted what was to become the genesis of the American Thanksgiving. It was celebrated after the Pilgrims had harvested their twenty acres of corn:

> Our harvest being gotten in, our governor sent four men on fowling, that we might after a special manner rejoice. The four in one day killed as much fowl as, with a little help beside, served the company almost a week. At which time, amongst other recreations, we exercised our arms, many of the Indians coming amongst us, and among the rest their greatest king Massassoit, with some ninety men, whom for three days we entertained and feasted, and they went out and killed five deer, which they brought to the plantation and bestowed on our governor, and upon the captain and others. And although it be not always so plentiful as it was at this time with us, yet by the goodness of God, we are so far from want that we often wish you partakers of our plenty.

Harvest home provided a reward for a long season of work on the land and fortunately took place during the only time in the year when there was a reasonable certainty of enough food.

A cluster of religious and secular feasts followed from late December to Lent, "bleak mid-winter" when, as the carolers sang, "frosty wind made moan, earth stood hard as iron, water like a stone." Food was still likely to be plentiful, especially freshly slaughtered meat.

A farmer removes a ham from the chimney where it was hung for winter storage. Smoke from the chimney helped to dry and flavor the ham, which will be washed and soaked before being eaten.

Harvested root vegetables, below, are often stored in the garden in straw-lined, earth-covered pits. At pig slaughtering time, right, kettles of water are brought to boil in individual homes, then carried to a large barrel in which the pig will be dunked to loosen its hair.

New Englanders would argue throughout the seventeenth century about the propriety of retaining these feasts, especially the more religious ones. For example, on Christmas Day, 1621, William Bradford criticized some of the Pilgrims for playing "stool ball and pitching the bar." He then "went to them and took away their implements and told them that was against his conscience, that they should play and others work. If they made the keeping of it [Christmas] a matter of devotion, let them keep to their houses; but there should be no gaming or reveling in the streets." But Christmas survived the Puritans; American winters were just too long to endure without a break.

Lent followed, a traditional, socially proscribed fast, appropriately occurring when the food supply was diminishing in both quality and quantity. Bradford remembered that one spring, "the best they could present their friends with was a lobster or a piece of fish without bread or anything else but a cup of fair spring water."

Winter symbolically ended with Easter. The dairy season had begun providing white meats, and surplus livestock, born during the winter, could be culled. Nicholas Breton captured the mood of 1626:

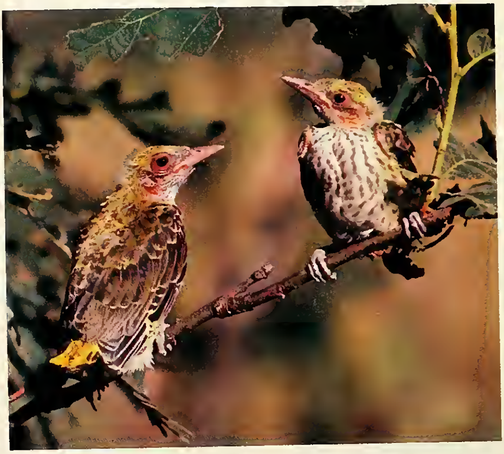
> Now begins the farewell to thin fare. . . . The butchers now must wash their boards, make clean their aprons, sharpen their knives, and cut out their meat for Easter-Eve . . . the cooks have their ovens clean, and all for pies and tarts against the merry feast . . . It is now Easter, and Jack of Lent is turned out of doors. The fishermen now hang up their nets to dry, while the calf and the lamb walk toward the kitchen and the pastry and the March rabbit runs dead into the dish.

The season that Tusser and others called the most dangerous time of the year ended with a feast, which wisely featured newborn livestock the farmer knew his pasture and fodder crops could not support. Sound ecological truths often underlie folk traditions.

But the seasonal feasts served a psychological function as well. Harvest home rewarded hard work throughout the summer; Christmas and the midwinter festivals encouraged families to keep going; and Easter acknowledged the good husbandman's skill at preservation and the entire household's ability to endure. By century's end, in thousands of New England villages and farms, folk gathered together to celebrate with "solid sufficiency and a hearty welcome." They had achieved the good life in the "best poor man's countrie." ☐

A Forkful of Orioles

Photographs by José Luis González Grande



Of the roughly thirty species of birds in the Old World family Oriolidae, only one is found in Europe—the golden oriole (*Oriolus oriolus*), which breeds from Britain and western Europe all the way east to central Asia and India. (The familiar orioles of North America belong to a different family, the Icteridae.)

Golden orioles return to Europe after a winter in Africa. Once they have arrived and paired off, they settle into open woodlands and parklands to build their cup-shaped nests. The nest, constructed primarily by the greenish yellow female with some help from the bright yellow-and-black male, is suspended between two slender, horizontal forked branches. Birds that cannot find a suitable fork may tie two branches together to make their own.

After securely attaching the rim of the cup to the supporting branches, the birds weave assorted materials, including stalks of grass, strips of bark, and pieces of wool, into the developing nest. The female lines the cup with wool, fur, feathers, bits of paper, and other soft items. Golden orioles are arboreal, remaining mostly in the trees; when they do descend to the ground, where they hop about in an awkward manner, it is mainly to gather nest materials.

Incubation lasts about two weeks, and the chicks hatch out blind and hungry. Both parents feed the nestlings, which leave the nest after about two weeks. The birds' diet consists largely of insects and larvae, spiders, other small invertebrates found in the trees, and when available, fruits. Later, as summer passes into autumn, the proportion of fruit in the diet increases considerably.

Soon after the chicks have left the nest, they begin to replace their down with the feathers of their first fall plumage. By the time fall comes, the juveniles are independent and ready to begin their first journey to the species' sub-Saharan wintering grounds. ☐

NO FOREIGN SEDAN CAN ROOM OF THIS CHEVROLET THIS CHEVROLET.

Chevrolet's 1983 front-wheel-drive Celebrity—a Chevrolet so precisely engineered it gives you twenty cubic feet more total room than the Datsun Maxima Sedan, seven more than Audi 5000.

Celebrity's front-seat leg room nearly equals some of America's biggest luxury cars; its trunk is more accommodating than a Rolls Royce. Yet Celebrity's

GM

Let's get it together...buckle up

*Use estimated MPG for comparisons. Your mileage may differ depending on speed, distance, weather. Actual highway mileage lower. Some

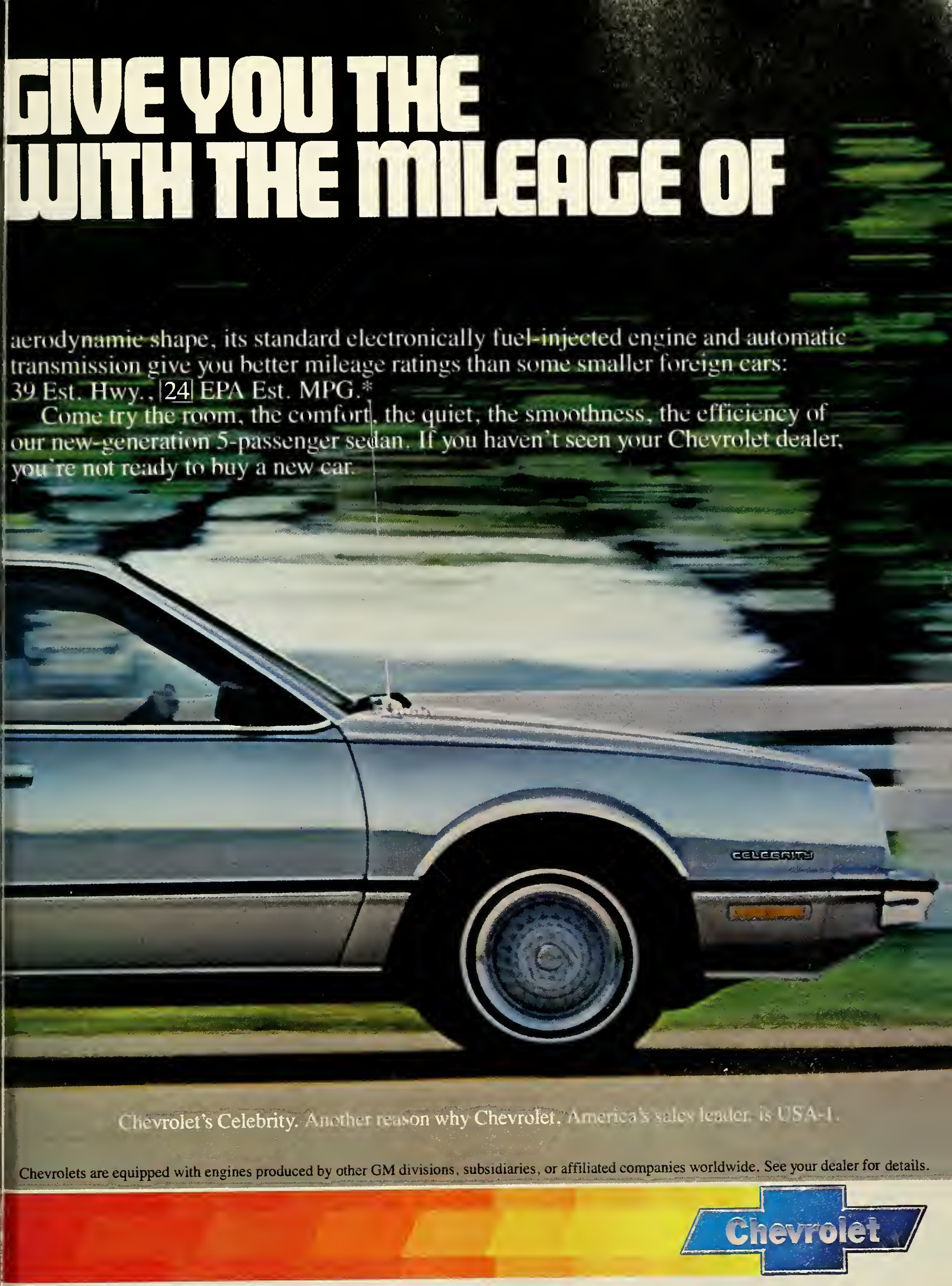
USA-1 IS TAKING CHARGE

CELEBRITY · CAVALIER · CHEVETTE · CAMARO · CITATION · MALIBU · MONTE CARLO · CAPRICE · CORVETTE

GIVE YOU THE
WITH THE MILEAGE OF

aerodynamic shape, its standard electronically fuel-injected engine and automatic transmission give you better mileage ratings than some smaller foreign cars: 39 Est. Hwy., $\boxed{24}$ EPA Est. MPG.*

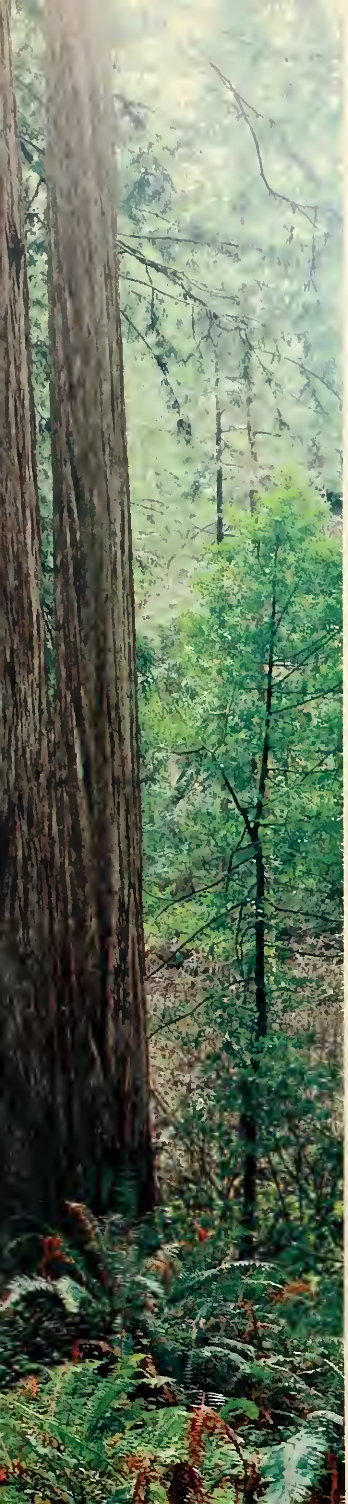
Come try the room, the comfort, the quiet, the smoothness, the efficiency of our new-generation 5-passenger sedan. If you haven't seen your Chevrolet dealer, you're not ready to buy a new car.



Chevrolet's Celebrity. Another reason why Chevrolet, America's sales leader, is USA-1.

Chevrolets are equipped with engines produced by other GM divisions, subsidiaries, or affiliated companies worldwide. See your dealer for details.

Chevrolet



The massive trunks of coast redwoods and other Pacific giants hold vast amounts of water. In the warm summer, when trees transpire more and thus need more water, these conifers supplement soil moisture with water from their stem reserves.
Loren E. Lane, West Stock

Land of the Giant Conifers

In the Pacific Northwest, majestic conifers thrive in a climate that makes life difficult for most hardwoods

by Richard H. Waring

In the winter of 1805–06, when Meriwether Lewis and William Clark first traversed Oregon to the Pacific Ocean, they wrote in their journals about forests of giant conifers—trees more than 36 feet in girth with spires that towered more than 250 feet. At that time, these giants dominated the Pacific Northwest, a region that extends from California north to Alaska and runs east from the ocean to the crest of the Cascade Mountains in the south and the Coast Mountains in the north. Some of the trees alive at the time of Lewis and Clark's expedition are still standing, and today the forests of the Pacific Northwest are known throughout the world. More than twenty species of conifers, representing ten genera, populate the region, and many are the largest and longest lived of their kind.

The forests that make up this mantle of greenery are not only impressive, as all who visit them will attest; they are unique among temperate forest regions of the Northern Hemisphere. Most forests of the north temperate zone are composed of hardwood trees or a mixture of hardwoods and conifers, and scientists have long speculated about why giant conifers dominate in the Pacific Northwest. Only recently, however, have ecologists addressed the question in detail.

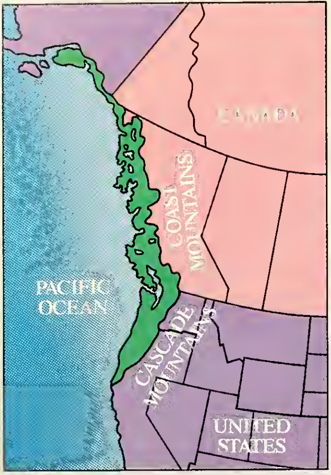
For millions of years, the region extending from northern California through Alaska to Siberia and Japan was largely forested with hardwoods. During most of that time—especially the early and middle Miocene, 15 to 30 million years ago—the Pacific Northwest conifers, which are of Asian lineage, were small in stature and restricted to harsh, high elevations, as are many conifers today in the Northern Hemisphere's subalpine zone. But by the early Pleistocene, more than a million and a half years ago and before any major glaciation had taken place, the makeup of the Northwest forests had changed dramatically. The conifers flourished and grew into giants, while many hardwoods, including genera still common in other temperate forest regions of this hemisphere, vanished. Today, hardwoods thrive only on disturbed sites where conifers either are not present or have not yet overtopped the shorter-lived hardwood species. What circumstances or adaptations might have favored the development of so many long-lived, massive trees? We are not sure, but as the findings of many studies are integrated, a picture is emerging.

The critical event seems to have been a change in climate from one suitable for hardwoods to one favorable to conifers. As the Cascade Mountains and the Coast Ranges rose up over the last ten million years, they influenced the development of a climatic regime that has existed in the area ever since. The mountains trapped moisture-laden clouds coming from the Pacific Ocean. At the same time, rainfall patterns shifted; summers became drier, while heavy, cool air draining down the mountain slopes resulted in lower night temperatures during the growing season. Interactions between mountain ranges and maritime and continental air masses produce some local variation in climate, but in general summers are warm and dry and winters are mild and wet. The region is often shrouded in clouds and fog. Dur-

Art Wolfe, West Stock

The Pacific Northwest region (green area of map, below) provides the giant conifers with a relatively gentle but not entirely benign environment. Fires periodically destroy the forests; strong winds carry out a more selective pruning, often toppling older trees already weakened by heartrot or injured by fire, right.

Karen Karlsson



ing their half-year sojourn, Lewis and Clark frequently noted the perpetually damp climate, which they found somewhat less marvelous than the giant trees.

More than 90 percent of the total annual precipitation falls during the so-called dormant season, from late fall to early spring. In other temperate forests, by contrast, precipitation falls relatively evenly throughout the year. The Pacific Northwest winter is also atypical of temperate zones in that daytime air temperatures are usually above 32°F and soils do not freeze. Even in the subalpine zone, where more than ten feet of snow may accumulate and remain until July, soils remain unfrozen. In the valleys and throughout most of the Coast Ranges, winters are even milder; snow seldom falls, and when it does, it is washed away by the next Pacific rainstorm.

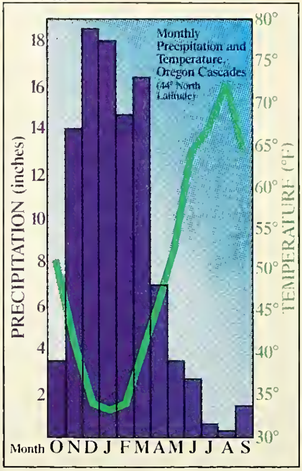
The mild winter weather and unfrozen soils have profound benefits for evergreen conifers. In a complex process called photosynthesis, all green plants combine carbon dioxide and water to produce carbohydrates, the chemical energy necessary to life. The conditions under which different kinds of plants are able to photosynthesize vary, however. Evergreen conifers can extract cold water even when soil temperatures are slightly below freezing, and many of them can continue photosynthesizing at air temperatures some degrees below freezing. So significant are these benefits that coniferous forests in the Northwest are estimated to accumulate from 30 to more than 50 percent of their total carbon products during the period from October through April. Deciduous hardwoods, on the other hand, shed their leaves in the fall and thus are totally dependent on stored reserves during the dormant season.

In most temperate forests, summer brings the warmth and rain on which deciduous hardwoods rely for growth. For trees growing in the Pacific Northwest, however, the summer growing season is the harshest time of the year. The rains nearly cease, and most of the region experiences extended summer drought. Water reserves in the soil may be largely exhausted and decomposition of litter may end, reducing the release of nutrients just when deciduous hardwood needs are greatest. Furthermore, atmospheric humidity is so low that leaf pores, called stomata, are nearly closed during most afternoons. This inhibits transpiration, the process by which water is taken in by the roots, pulled up through the tree, and ultimately released—primarily through leaf stomata—as water vapor. Because efficient uptake of water and minerals occurs only when leaves are actively transpiring, deciduous hardwoods are at a disadvantage in a climate where water is available mainly when they lack leaves.

The closing of the stomata causes additional difficulties: it prevents the atmospheric carbon dioxide needed for photosynthesis from entering the leaves. In the coastal valleys and at the seaside, where summer fog occurs, the moisture deficit is reduced, but so is the absorption of solar radiation. Decreased sunlight and closed stomata impede photosynthesis in both hardwoods and conifers. Again, however, the hardwoods suffer more than the ever-

Dominated by Douglas fir and hemlock, the west-central Cascades of Oregon receive about 100 inches of precipitation annually. But this moisture falls unevenly throughout the year. The warm summer months are dry, putting deciduous hardwoods, totally dependent on the summer for growth, at a disadvantage.

Karen Karlsson



green conifers, which are not so dependent on the summer growing season.

Besides the ability to photosynthesize all year, the Northwest giants have large reservoirs in which to store water, minerals, and carbohydrates. Trees carry water and minerals upward from roots to foliage through sapwood, a wide band of dead, but porous, conducting cells in the outer part of the wood. Sapwood also contains horizontal bands of living cells, called ray parenchyma, adjacent to each vertically aligned conducting cell. Ray parenchyma store carbohydrates that are transported downward from leaves through the inner bark. These living cells represent only about 5 percent of the total sapwood volume in conifers (compared with 10 to 15 percent in hardwoods), but because the Pacific trees are so enormous, ray parenchyma form a storage reservoir equal to or exceeding that of the foliage, the other part of trees in which the carbohydrate products of photosynthesis accumulate.

This large volume of sapwood aids the conifers in several ways. Because the foliage is often 100 feet above the ground, the reserves held in the sapwood are the first drawn upon to heal wounds from fire, boring insects, or disease. In addition, sapwood reserves in the woody root system yield the carbohydrates necessary to grow most of the small feeder roots put out every spring.

Perhaps most important, the massive conducting tissue serves as an auxiliary water reservoir during the summer. On most warm, dry summer days, when evaporation is high, the roots cannot transport water fast enough to the leaves. Instead, water is withdrawn from twigs and stem reserves to meet the deficit. The reserves are usually recharged from the soil at night when transpiration ceases. In many conifers, the reservoir provides a third of each day's water requirement; in the giants of the Northwest, the reserves are sufficient to meet at least a ten-day requirement at maximum transpiration rates. Hardwoods in the region are unable to hold even one day's needs in reserve.

Hardwoods also generally have fewer nutrient reserves and higher nutrient requirements than do conifers. Mature conifers replace only about 15 percent of their foliage every year, and individual leaves may live for thirty years; deciduous hardwoods replace all their leaves every year. Moreover, conifers can withdraw as much as two-thirds of certain required nutrients from older foliage, while hardwoods can meet less than one-third of their springtime nutrient requirement this way. They must rely on the uptake of nutrients from soil and litter on the forest floor.

The giant conifers do not owe their position in the Pacific Northwest to superior physiological adaptations alone; their very shape helps foster their dominance. A pyramidal crown efficiently absorbs solar radiation at low sun angles and under cloudy skies, conditions common throughout the dormant season. In parts of the Northwest where deep and heavy snows accumulate, some conifer species, such as mountain hemlock and subalpine fir, have a particularly narrow shape. The branches of these trees are reduced in length and deflected downward. This increases the trees' ability to shed snow from their leaves, making it

Evergreen needles enable conifers such as this western red cedar to take advantage of the Pacific Northwest's mild, wet winters and to photosynthesize year-round. In the drier summer, fog condenses on the many needle-shaped leaves, adding to the tree's water supply.

Entheos

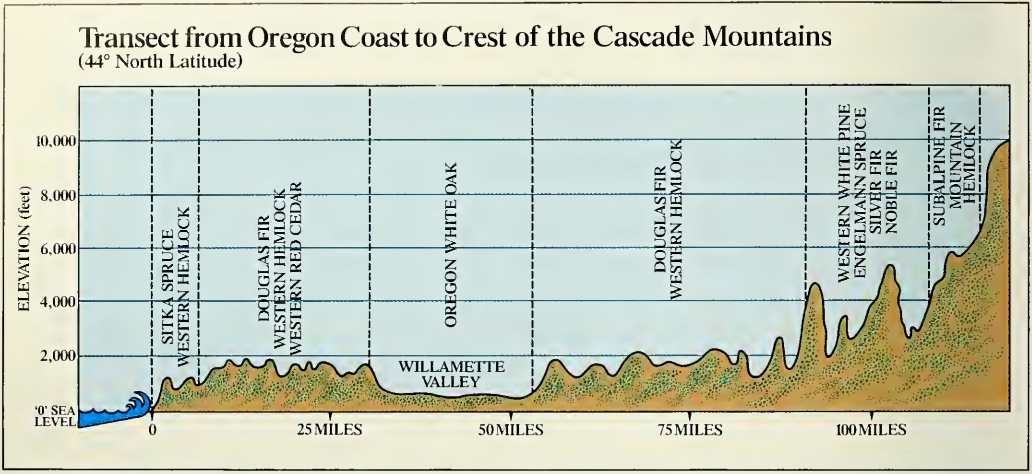
Under especially favorable growing conditions, conifers can reach truly spectacular ages and proportions. Among the trees that have been measured are a Douglas fir more than 400 feet high, a western red cedar nearly 21 feet in diameter, and a 3,500-year-old Alaska yellow cedar. Forests made up of these giant conifers accumulate more biomass than temperate and tropical forests in other parts of the world; redwood forests, for example, can contain more than 3,300 tons of biomass per hectare.

AGES AND DIMENSIONS OF TYPICAL MATURE TREES IN PACIFIC NORTHWEST FORESTS

SPECIES	AGE Years	DIAMETER Inches	HEIGHT Feet
Silver fir (*Abies amabilis*) Central British Columbia through Oregon, high mts.	400	40	160
Noble fir (*Abies procera*) Washington to NW California, high mts.	400	50	190
Port Orford cedar (*Chamaecyparis lawsoniana*) SW Oregon and NW California, coastal belt	500	55	195
Alaska yellow cedar (*Chamaecyparis nootkatensis*) British Columbia to N California, mts.	1,000	50	115
Western larch (*Larix occidentalis*) SE British Columbia to central Oregon, mts.	700	55	165
Incense cedar (*Libocedrus decurrens*) W Oregon to S California and N Baja California, widely distributed	500	35	120
Engelmann spruce (*Picea engelmannii*) Central British Columbia to California and New Mexico, high mts.	400	40	160
Sitka spruce (*Picea sitchensis*) S Alaska to NW California, coastal belt	500	80	240
Sugar pine (*Pinus lambertiana*) SW Oregon through central California, mts.	400	45	165
Western white pine (*Pinus monticola*) S British Columbia to California, mts.	400	45	195
Ponderosa pine (*Pinus ponderosa*) SE British Columbia throughout the West, widely distributed	600	40	130
Douglas fir (*Pseudotsuga menziesii*) Central British Columbia throughout the West and into Mexico, widely distributed	750	70	245
Coast redwood (*Sequoia sempervirens*) SW Oregon and California, coastal belt	1,000	100	290
Western red cedar (*Thuja plicata*) SE Alaska to NW California, mts.	1,000	90	195
Western hemlock (*Tsuga heterophylla*) S Alaska to NW California, coastal belt and mts.	400	40	190
Mountain hemlock (*Tsuga mertensiana*) S Alaska to central California, high mts.	400	35	115

Within the Pacific Northwest, climate and topography vary considerably. As conditions change, so do the species that dominate the forests, as shown on the transect below (vertical relief is exaggerated twenty times relative to the horizontal scale). Conifers grow to great heights along the coast and on the mountains up to elevations of about 5,500 feet. Forests may be mixed or pure; the stand at right consists of relatively young Douglas fir, 100 to 125 years old. Hardwoods occur primarily as pioneer species or in more severe environments. Much of the Willamette Valley, for example, which is leeward of the Coast Mountains and therefore drier than the rest of the region, is dominated by white oak. Conifers at high elevations, such as subalpine fir and mountain hemlock, seldom reach the heights of trees at lower altitudes.

Karen Karlsson



possible for them to take advantage of the winter sun and photosynthesize.

The needlelike shape of conifer leaves has also been carefully tailored by evolution. The needles' narrowness causes them to dry quickly, a distinct advantage during the rainy season. Were the foliage to remain wet, transpiration and the associated mineral uptake would be minimal during the winter. In the dry summer, fog is caught by the dense canopy of needles, quickly condenses, and drains off the narrow leaves, measurably supplementing rainfall during the drought period. Moreover, although both conifers and hardwoods control water loss by closing stomata, the narrowness of conifer foliage dissipates heat more efficiently and prevents leaves from reaching lethal temperatures when transpiration is inhibited. When stomata are closed in hardwoods, the temperature of the leaves rises, metabolic activity increases, and carbohydrate reserves are depleted.

Each needle-shaped leaf is small, but conifers carry a huge number of them. As a result, their total surface area is large, which makes them efficient filters of atmospheric dust and gases. In the relatively unpolluted Northwest, this is a definite advantage. Minerals deposited on the leaves are leached to the roots or trapped on foliage and eventually made available for uptake as the leaves fall and decompose.

The many traits of conifers—shape, large storage reserves, efficient use of nutrients, year-round photosynthesis—are crucial to their dominant position in the Pacific Northwest, but they do not result in exceptionally high growth rates. Annual productivity in these coniferous forests is comparable to that of many hardwood forests in other temperate regions. The conifers, however, can continue to grow in height for centuries and in diameter until they die, often after more than a thousand years. This ability to thrive for hundreds of years after attaining spectacular heights distinguishes these conifers as giants and contributes to forest stands with biomass accumulations far exceeding those of other north temperate forests. Most hardwood forests rarely accumulate more than 550 tons of biomass per hectare, while coniferous forests in the Northwest often reach 1,000 tons per hectare and, in the case of redwood, more than 3,300 tons.

A variety of other factors, more or less directly related to climate, contribute to the giant conifers' success. Winds in the region, except those directly on the coast or on mountain ridges, are relatively gentle. Unlike all other north temperate forest regions, hurricanes and tornadoes are rare. Storms do blow down patches of trees but not whole forests, as happens at less than one- to two-century intervals in Japan, Europe, and much of the eastern United States.

Periodically, the giant coniferous forests have been destroyed by fire. More than a century before Lewis and Clark, a Spanish sea captain noted in his log that he had to sail more than twenty miles off the coast to keep flying embers from setting his rigging aflame. Generally, however, when fire burns through the understory of such a forest, its flames are unlikely to reach the lower branches of the lofty overstory trees or to penetrate their protective bark, which may be more than a foot thick; hardwoods have no such advantages. Fires in the region occur infrequently, perhaps one a century. At that rate, they provide increased nutrient cycling and clear away encroaching understory vegetation, thus reducing competition and preventing a buildup of fuel for potentially more serious fires.

Some hardwoods, such as alder and snowbrush, play a special role after a catastrophic fire destroys a coniferous forest. Associated with the roots of these widely distributed plants are symbiotic bacteria (actinomycetes) that change atmospheric

Paul Kotz, West Stock

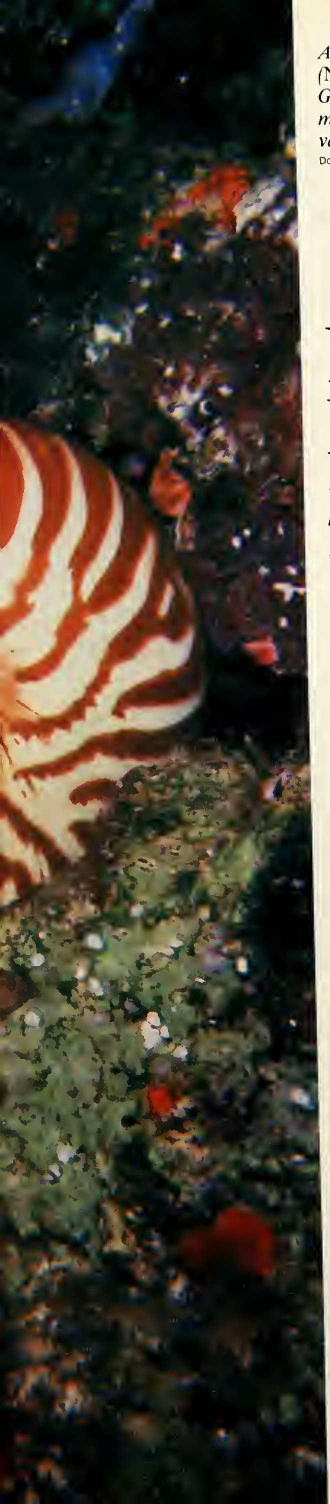
nitrogen into organic fertilizer at annual rates of 110 to 440 pounds per hectare. These plants germinate in the ashes left by the fire, and once the nitrogen they fix is incorporated into the soil, it stimulates and then maintains the growth of another generation of conifers.

Pathogens are active throughout the region but generally cause mortality only in younger coniferous forests, essentially weeding them and leaving growing space for the survivors. In the older forests, heartrots slowly decay nonliving wood in the trunks of trees previously injured by fire or infected with root rot. Even with heartrot, however, the trees may live for centuries until they are finally toppled by wind. The wood of some Northwest conifers, including western red cedar and redwood, is impregnated with protective tannins. These trees remain so resistant to fungal attack that their corpses are still around a century after falling to the ground. Even parasites such as dwarf mistletoe, a scourge of forests east of the Cascades, are notably ineffectual in, or absent from, most of the giants' realm. Where they are active, they kill only a few limbs or smaller trees.

Conifers are generally less palatable to insects than hardwoods, which have more nutritious foliage. Although certain insects occasionally defoliate or girdle some giant conifers, their activity is usually limited to forests suffering from damage caused earlier by wind, fire, or pathogens.

Perhaps the biggest threat to the giant conifers today is human activity. Although the coniferous forests still dominate the Pacific Northwest, their realm is much smaller now than in the time of Lewis and Clark. We might imagine that the giants are now protected in the more than one million acres of parks, research forests, and wilderness areas set aside for them in the United States. But our protective policies may be overzealous. History teaches us that nature restores these forests with episodic fires, waves of hardwoods, and even epidemics of pests. In human hands now lie the knowledge and responsibility to perpetuate—or doom—the largest forms of life this planet has ever known. □

Most conifers have a pyramidal or conical crown. These shapes facilitate the absorption of solar radiation on cloudy days and when the sun is low in the sky, common conditions during the Pacific Northwest winter.
Art Wolfe



*A pair of juvenile nautiluses (*N. belauensis*) consume bait off the Great Reef of Palau. Their heavily muscled beaks enable them to eat a variety of crustaceans.*
Douglas Faulkner, Photo Researchers

Nautilus: Have Shell, Will Float

The last of the shelled cephalopods can regulate its buoyancy by filling or emptying chambers in its intricate shell

by Peter D. Ward

The nautilus, whose elegantly spiraled shell adorns many coffee tables, holds the interest of scientists for more than its beauty and form. Paleontologists often attempt to reconstruct the biology of extinct organisms by studying morphologically similar living species. The study of *Nautilus*, the last living genus of externally shelled cephalopods, has been especially fruitful in this respect. During the Paleozoic and Mesozoic eras, more than 10,000 species of nautiloid and closely allied ammonoid cephalopods evolved, all relying on the use of internally partitioned shells for buoyancy. Much of what we infer about the paleobiology of these extinct chambered cephalopods comes from comparisons with modern nautiluses.

The buoyancy system of the nautilus has long intrigued observers. Scientists have attained a good understanding of how nautiluses regulate their buoyancy—and hence depth—and have dispelled some misconceptions in the process. Nautiluses make themselves neutrally buoyant in the sea through the use of gas-filled chambers in the shell. The saline liquid that originally filled these chambers is removed by osmosis through the siphuncle, a thin strand of tissue that extends back from the nautilus' body through each chamber. As a nautilus grows, producing new flesh and shell material, it becomes progressively denser. By removing liquid in small volumes each day, a nautilus can counterbalance density increases.

This system can even be used to regulate buoyancy after an unsuccessful predatory attack. If part of a nautilus shell is broken off during an attack, the nautilus suddenly becomes lighter. But then, as the experiments of Lewis Greenwald of Ohio State University and myself have shown, the nautilus will shut off the pumps in the siphuncle, resulting in the slow refilling of the last several chambers with liquid until neutral buoyancy is again achieved. As new shell material grows back, liquid is again pumped out.

The buoyancy system allows the nautilus to increase shell size but remain at a constant weight in seawater. Contrary to earlier belief, it does not allow the nautilus to ascend or descend rapidly. The emptying or refilling of chambers takes days, not hours, preventing rapid buoyancy change.

Little is known about the natural history of this fascinating but enigmatic animal. The living species of nautiluses are confined to the western Pacific Ocean and perhaps parts of the Indian Ocean. Field studies on the distribution of nautiluses around a number of Pacific archipelagoes and islands, most notably the Philippine Islands, New Caledonia, Palau, and the Fiji Islands, have resulted in new knowledge about the depth distributions of the various nautilus species in these areas. In all of these settings, nautiluses appear to be common in fore-reef slope habitats, at depths to 2,000 feet.

Because of the great depths involved,

*Cruising slowly at a depth of one hundred feet, a nautilus (*N. macromphalus*) drags its tentacles along the substrate.*

Peter D. Ward

nautiluses usually have to be trapped with baited wire cages. Only in Melanesia (New Caledonia, the Loyalty Islands, and the New Hebrides) do nautiluses occur in waters shallow enough to allow prolonged observation by scuba divers. In Melanesian waters, nautiluses have been observed at depths of less than 300 feet. In some cases, always at night, they have been observed near the surface.

Arthur Willey, an English zoologist who traveled through the Indo-Pacific region near the turn of the century, was the first scientist to observe the near-surface nautiluses. Noting that sightings occurred only at night, Willey concluded—logically but, recent research suggests, probably incorrectly—that the nautilus, like many other marine organisms, migrated upward during the night to feed. Willey was wise enough not to attempt to quantify either the numbers of nautiluses engaging in this behavior or the frequency and vertical displacement of the migrations. Nevertheless, his conclusion had enormous influence on paleontologists attempting to interpret the paleobiology of the numerous species of extinct chambered cephalopods. Even today, Willey's report about vertical migration can be found in virtually every general discussion of nautiluses or extinct nautiloids and ammonoids. This, coupled with the mistaken belief that the nautilus is capable of rapidly adding or subtracting water in the shell (and thus quickly ascending or descending), made nautiluses appear to be like submarines. No wonder so many submersible craft—in both fiction and fact—have been named *Nautilus*. But with access to today's information, Jules Verne would have picked a different name for Captain Nemo's submarine.

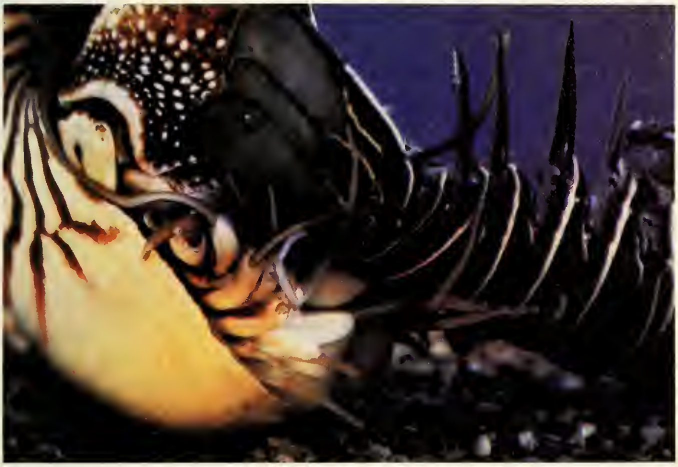
Much recent nautilus research has been carried out in New Caledonia, which has the twin advantages of nautiluses appearing in waters shallow enough to allow direct observation and capture by divers and modern research facilities at the Aquarium of Noumea. New Caledonia is a long, narrow island with barrier reef systems along each of its coasts. These barrier reefs, each about 350 miles long, parallel the nearby Great Barrier Reef of Australia and share many faunal elements with that reef system.

The New Caledonian barrier reefs are as much as 12 miles from the coastline of the island, and thus enclose large lagoons. The seaward side of each barrier reef, after a shallow terrace of several hundred yards width, drops quickly down to abyssal depths. The outer reef slopes are composed of sheer, nearly vertical precipices alternating with less steeply dipping, narrow plateaus where sediment accumulates. At depths of less than about 600 feet, these plateaus are covered with reef talus and carbonate sand; deeper than 600 feet the sediment is mainly an organically rich mud that supports large populations of fish, crabs, shrimp, isopods, and nautiluses. Trapping studies in New Caledonia show that the highest populations of nautiluses are on these plateaus, at depths of between 1,000 and 1,600 feet. The maximum depth at which nautiluses can be trapped is about 2,000 feet; at 2,400 feet, the shells implode.

We are only beginning to appreciate the importance of nautiluses in reef ecosystems. Based on the ease of trapping specimens and the presence of many drifted shells on beaches across the reach of the Pacific, nautiluses appear to be numerous. To understand their ecological position in the fore-reef slope communities, it is necessary to better understand their diet. In aquariums they eat a variety of meats. But firmly establishing the natural diet of deep-living nautiluses has not been possible. Nautiluses consume a variety of crustaceans and small fish found with them in traps, but these may not be their natural prey. To date, the only information about diet and ecological posi-

*Making a meal of the molted exoskeleton of a spiny lobster, a nautilus (*N. macromphalus*) gains considerable protein. Its muscular stomach is lined with a horny cuticle, protecting it from the jagged edges of the ingested molt.*

Peter D. Ward



tion of any nautilus species comes from field studies and dissections of *Nautilus macromphalus* from New Caledonia that were caught by hand in water of less than 200 feet.

At night, the New Caledonian barrier reef displays a completely different array of animal inhabitants from those normally observed by day. Most noticeable are the clouds of polychaete worms and small crustaceans that rise up toward the surface from shelters within the reef, their huge numbers turning the water turbid in places. A variety of spiny and scyllarian lobsters, shrimp, and crabs move about the reef in search of food. Preying on these arthropods are hosts of octopuses, cuttlefish, and nautiluses.

From a distance the nautiluses are wraithlike: pale figures moving slowly but purposefully above the substrate, dragging two tentacles across the surface of the reef. They are often found with what may be one of their favorite shallow-water meals: the molted exoskeletons of spiny lobsters or slipper lobsters. This observation confounded biologists when first made in 1975. Were nautiluses mistakenly attacking the exoskeletons, much like the futile attacks of many predatory snails on already empty barnacles or bivalves, or were the nautiluses actually consuming these molts? Further observations on the reef at night, in conjunction with studies in the aquarium, shows that the molts are actually ingested. The nautiluses eat nearly all the parts of the exoskeleton over a period of several hours. Only the harder cephalothorax is left untouched, either because it has lesser nutritional value or more probably because of its denser calcareous component. All of the other parts of this type of molt have flesh and membrane in addition to the hard calcitic parts, and the nautilus obtains considerable protein from molt consumption. The molts of large crabs, which like the cephalothorax of the spiny lobsters are densely calcareous, have not been observed as food sources of the nautilus.

I have never observed a predatory attack on live crustaceans during night dives, probably because of my bright diving lights. When first fixed by lights, nautiluses, which appear to live in near or absolute darkness most of their lives, begin to swim rapidly and erratically. Information about predatory activities has come from dissections of a dozen hand-caught specimens. These results show that *N. macromphalus* eats much more than lobster molts. Fish remains and a variety of crustaceans, such as brachyuran, pagurid, and galatheid crabs, have been found in their stomachs. The most common prey has been a large hairy hermit crab, *Aniculus aniculus.*

The predilection of *N. macromphalus* for this particular type of hermit crab adds a new chapter to an already classic story of cooperative animal relationships. Largely through the work of D. M. Ross of the University of Alberta, researchers have learned that certain hermit crabs are protected from attack by octopuses and other cephalopods if their shells carry anemones, which will sting attackers. Ross has shown that these hermit crabs actually attach the anemones onto their shells. The hermit crab *Dardanus megistos* is common in New Caledonia in the same environments as the nautilus. Numerous specimens, their shells covered with anemones, are commonly found in the traps with nautiluses and are observed on the same shallow reefs at night. Remains of this species of hermit crab have never been found in the guts of a nautilus, not even in those brought up in traps containing numerous crabs. In an aquarium, the nautilus will approach the anemone-covered shells of *D. megistos* and then, like the octopuses in the experiments of Ross, quickly shy away. Unlike the *Dardanus* hermit crabs, *Aniculus* crabs do not carry anemones—and apparently pay the price.

Nautiluses, in contrast to many other cephalopods, have no toxin for killing their prey and do not sort or strip their crustacean prey before ingesting them. Instead, the nautilus alimentary canal seems well designed for dealing with the carapaces of their crustacean prey. Compared with the beaks of most other cephalopods, the beak of the nautilus is extremely massive and heavily muscled. It is tipped with calcareous cutting edges, capable of biting through thick chicken bones. After ingestion, food passes into an expandable crop where it can be stored, then travels to a muscular stomach, whose walls are lined with a horny cuticle to protect them from the jagged edges of the broken carapace remains. The carapace material is broken down in the stomach through action of the muscular walls and the secretion of a strong acid.

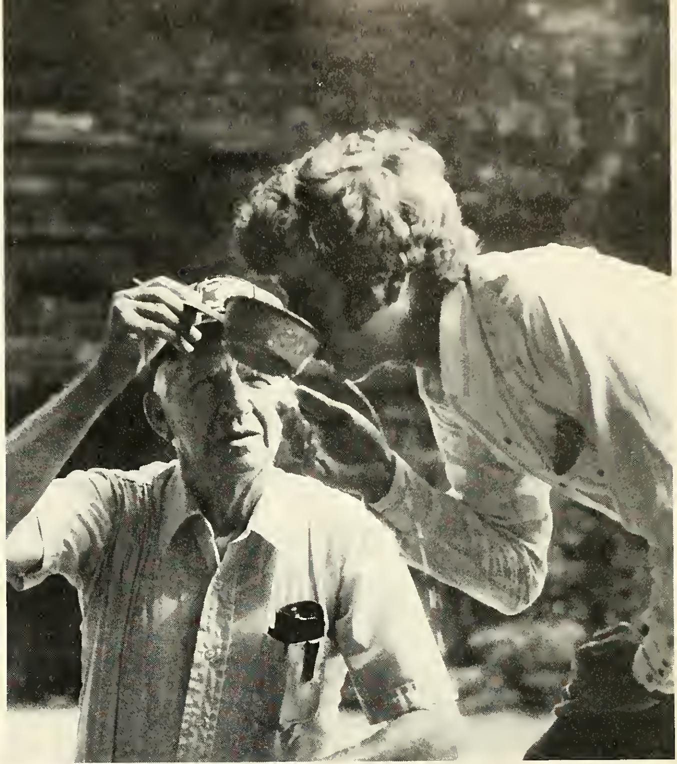
By regulating the amount of liquid in the chambers of its shell, a nautilus can adjust its buoyancy. As the animal grows and becomes denser, it compensates by removing a corresponding amount of liquid, which is replaced by gas.
Michael Melford

An octopus removes meat from its crustacean prey before eating it, but the nautilus ingests the exoskeleton as well as the enclosed meat. Consumption of such a large volume of calcium material, which is constantly bathed in acidic digestive fluids, must result in the adsorption of large amounts of calcium and phosphate into the walls of the alimentary canal. Perhaps as a result of this diet, nautiluses, virtually alone among cephalopods, produce large volumes of kidney stones—sometimes two to three grams of them.

When nautiluses reach a certain size, they cease growing. Once this maturity is reached, the shell attains unmistakable characteristics, the most notable being the development of a deep eye indentation on the aperture. To date, all of the observed nautiluses have been nearly or fully mature; juveniles have never been seen in the shallow-water areas. If an upward nocturnal migration takes place, only the larger, mature specimens participate. Trapping studies of nautilus populations in New Caledonia confirm a depth stratification by size with the nautiluses in less than 1,000-foot depth larger than those in greater depths.

Additional evidence also suggests that large-scale vertical migration may not take place. I have caught *N. macromphalus* by hand at night, as well as in baited traps from depths of 165 feet or less, that show conspicuous growth of green algae on the exterior shell. Such algal growth could only take place in the photic zone, which in New Caledonia is probably less than 300 feet. Also, we know from numerous observations of nautiluses in shallow water made immediately after sunset that more and more animals do not arrive as the night wears on; rather, the nautiluses appear suddenly as soon as darkness arrives.

Recent studies have given a small glimpse into the ecology of this strange animal, so cherished by paleontologists and shell collectors. We now need to pursue ecological studies at the depths where the nautiluses are most abundant—the deep, muddy plateaus of the 1,000–2,000-foot fore-reef slope. Such studies will certainly be applauded by paleontologists. ☐



If you'd like a booklet telling you more about our water and our whiskey, drop us a line.

YOU CAN TASTE a secret of Jack Daniel's Whiskey without putting liquor to your lips.

Visit our Tennessee distillery and Lamont Weaver here will take you to an unusual cave. It's fed by an underground stream of iron-free water never exposed to outside air. And this is the only water we've ever used for making Jack Daniel's. Just a dipperful from our spring and you'll know why Jack Daniel settled here. Just a sip of his whiskey, and you'll be glad we've never left.

CHARCOAL
MELLOWED
◊
DROP
◊
BY DROP

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery
Lem Motlow, Prop., Inc., Route 1, Lynchburg (Pop. 361), Tennessee 37352
Placed in the National Register of Historic Places by the United States Government.

Jack Daniel's
Old No. 7
Tennessee
Whiskey

MARGARET MEAD
A Voice for the Century
by Robert Cassidy

"An excellent distillation of Mead's work and travels."
—*The Boston Globe*

"Excellent....Not only educates but entertains as well."
—*The Los Angeles Times*

At your bookstore, or send $14.00, postpaid, to UNIVERSE BOOKS,
381 Park Ave. South, NY, NY, 10016

MATH WITHOUT TEARS

Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written.
Learn math in the comfort of your own home at minimum cost.

Order Now: $11.95 plus $1.25 hdlg
EMERSON BOOKS, INC.
Dept. 636-G, Verplanck, NY
10596
10 Day Money Back Guarantee

For the tenth year we offer intrepid travelers the world's most challenging and rewarding tourist experience

Greenland Dog-sledging Expedition

MARCH 26 TO APRIL 9, 1983

Ten days are spent on Greenland's breathtaking West Coast under the expert guidance of a leading Arctic explorer. Travel is by helicopter and husky-drawn sledges.

Detailed brochures of this expedition and a copy of our newsletter which lists all our fascinating travel programs available from

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

HANOVER SHOE

PREMIUM SHOES LOW PRICES!

You can order the finest premium leather men's shoes at low, factory-direct prices from Hanover, a leading name in shoes since 1899. Known for quality, Hanover's expanded line includes hundreds of styles this year, both dress and casual, as well as shirts, ties, accessories, and women's shoes.

Free Catalog Send today for our free 32-page full color catalog & special money-saving Introductory Offer.

MAIL TO: **The Hanover Shoe, Inc.**
Box 340, Dept. 9218, Hanover, PA 17331

☐ *Please send free catalog*

Name____________________

Address____________________

City/State____________ Zip______

Margaret Mead Film Festival

The 1982 Margaret Mead Film Festival, the largest showing of anthropological films in the world, will be held at the American Museum of Natural History on the evenings of Monday, October 4, through Thursday, October 7. Screenings are free to all Museum visitors.

Margaret Mead was an early pioneer of film in anthropology and a strong believer in bringing anthropology to the general public. Five years ago she established the first film festival at the Museum as a forum for both classic and recent anthropological films. This year, the festival will present sixty-five films, of which twenty-six are New York premières.

Two major themes in this year's festival are *Looking at America* (in which the anthropological eye of the camera is turned on us for a change) and *Cultures in Transition* (films documenting how the pressures of the modern world are transforming, and sometimes clashing with, traditional cultures). Films on these major themes will be shown in the Museum Auditorium. Other themes, to be presented in the Kaufmann and Linder Theaters and the Leonhardt People Center of the Museum's Charles A. Dana Education Center, are: *Dance and Performance, Ritual and Religion,* and *Fieldwork on Film* (Kaufmann Theater); *Village Life, Art Traditions,* and *Native Americans* (Linder Theater); *Films by Margaret Mead* and *Urban Life* (Leonhardt People Center). Among the highlights will be:

The Life and Times of Rosie the Riveter (1980). Auditorium, Tuesday, October 5, at 6:30 P.M. Filmmaker Connie Field interviewed five women (three black, two white) now sixty or older, who were re-

David Westphal

Toronto taxi dispatcher Syd Glass in the documentary Taxi cruited to work in defense-related industries during World War II. Portions of interviews are skillfully interwoven with newsreel footage, wartime propaganda clips, and other vintage film. We see how government-inspired propaganda manipulated women — first to encourage them to join the wartime labor force, then to encourage them to return to the role of homemaker and yield their jobs to returning servicemen.

The Gold Pit (1982). Auditorium, Tuesday, October 5, at 8:55 P.M. The film focuses on two men who speculate in gold at the New York Commodities Exchange. The "gold pit" is the exchange floor where traders bid aggressively against each other in an atmosphere of apparent chaos. This film shows us a frenetic world of losers and winners, in which a man's feelings of masculinity depend upon whether he is ahead or behind in the gamble against the constantly fluctuating value of gold. And yet, as each man talks, it becomes clear that each gains emotional satisfaction from his work despite the psychological toll exacted on the trading floor.

Magic in the Sky (1982). Auditorium, Thursday, October 7, 7:35 P.M. Produced by the National Film Board of Canada, this film looks at the impact of television on the Inuit peoples of the Canadian Arctic. Since 1973 television has penetrated the Arctic, and the effect on remote Inuit communities has been severe. A new world has suddenly appeared in their homes—a competitive world that emphasizes the individual and contrasts sharply with Inuit traditions of sharing and cooperation. We see, for example, an Inuit family watching the *Edge of Night* and American game shows—which stress the eagerness of individuals to acquire wealth and status. The high point of the film comes when, in March 1981, a large Inuit community goes to the polls to vote on the proposed introduction of television to their village. Even though assimilation of the Inuit has been a goal of the Canadian government, the people narrowly voted to bar TV from their town.

INDIA.
COME FOR THE SIGHTS AND INSIGHTS.

The last of the Bengal tigers

India has many cuisines

One of our quiet, palm-fringed beaches

Modern, luxurious hotels

"I am the essence of the waters,
the shining of the sun and the moon."
Bhagavad-Gita

India will open your mind—and make your vacation dreams come true.

India, with its temples and mosques and monasteries and churches, is where all religions meet.

It's where art and architecture date back thousands of years.

And birds and tigers rest in wildlife sanctuaries.

India is surrounded by ocean and mile after mile of unspoiled beaches.

And bordered by the world's highest mountains.

In India you can practice yoga. Or ski. Or shop in our colorful bazaars (where you can bargain in English).

It is a land of varied and beautiful experiences.

All unforgettable.

See your travel agent.

UNBELIEVABLE INDIA

Please send me information on Unbelievable India. NH-10

Name ____________________

Address ____________________

City ____________________

State, Zip ____________________

GOVERNMENT OF INDIA TOURIST OFFICE
30 ROCKEFELLER PLAZA, NEW YORK, N.Y. 10112 (212) 586-4901. 3550 WILSHIRE BLVD., LOS ANGELES, CA 90010 (213) 380-8855
523 37TH AVE., SAN FRANCISCO, CA (415) 386-8284. 230 N. MICHIGAN AVE., CHICAGO, IL 60601 (312) 236-6899
POST BOX 342 T.D. CENTRE, TORONTO, CANADA (416) 362-3188. MIAMI, FLA (305) 944-7039 DALLAS, TEXAS (214) 234-2233

Pamper Yourself...
with fine designer lingerie!
INTIMIQUE™
A Unique Collection of Luxurious Designer Lingerie!

Indulge yourself with our lacy, elegant camisoles, French pants, bra and panty sets, teddies, gowns and other luxurious lingerie from fine designers like Montenero, Stillman, Lorê and others.

Send $2.00 to receive our exclusive Catalogue of Designer Lingerie. Mail to Intimique, Dept. 9102 One Eastwood Drive, Cincinnati, Ohio 45227.

J.M.W. TURNER OFFER

Castle Upnor, Kent: (22 X 18 in.)
Painted 1830: Private Collection England.

Superb quality colour print of a strikingly beautiful Turner watercolour. Warships lie at anchor silhouetted against the setting sun, while in the foreground fishermen prepare for the homeward journey as evening sets in. Art historian John Ruskin wrote, "This is a wonderful example of Turner at the peak of his powers."
Just one thousand copies of this painting were printed in England to commemorate Britain's Maritime History Year. We have every one of them. There will be no more available once these few are gone.

Print $16 (Framed $59.90)
Calif. rsidents add 6½% tax. Tel. (213) 452-2443

OXFORD GALLERIES
2210 Wilshire Blvd., Suite 627
Santa Monica, CA 90403

Name________________
Address________________
City__________ State____ Zip____
☐ VISA ☐ M.C. #__________ Exp.______

ANTHROPOLOGY TOUR TO MOROCCO
March 25 to April 9, 1983
American Museum of Natural History
Discovery Tours

Journey through Moroccan cities and countryside to visit the famous medieval city of Fes, the souks of Marrakech, and camel markets at Rissani, the Atlas Mountains and the Sahara Desert. Visits to Berber villages; archeological sites and museums in Tangier, Rabat, Roman Volubilis and Lixus. Tour is led by Paul J. Sanfacon, Lecturer in Anthropology at the Museum. Limited to 20 participants. For further information write to DISCOVERY TOURS, American Museum of Natural History, Central Park West at 79 St., NY NY 10024, or call (212) 873-1440.

Drikung: A Faith in Exile (1981). Kaufmann Theater, Wednesday, October 6, 7:15 P.M. This beautifully photographed film looks at the Drikung sect of Buddhism, driven from Tibet by the Chinese and now living in India. The focus is on Rimpoche, the Drikung leader-in-exile who escaped from Tibet in 1975 and set about to rebuild the sect's monastery in India. The film's climax is the four days of celebration around the 800th anniversary of the founding of the sect, when a giant tangka (religious tapestry) was unveiled for the occasion.

Workshops for Young People

The Department of Education offers exciting weekend courses for children this fall. In addition to four- and five-week courses on *Animal Drawing, Reptiles,* and *Human Physiology,* two half-day workshops are offered on *Dinosaurs* and *Archeology.* These courses, designed for children in grades 3 through 8, begin October 16. For a brochure and registration form call the Department of Education at (212) 873-7507.

Where the Rainbow Came From

On Saturday, October 16, Jerry Vovcsko's talents as a musician, magician, and storyteller will be displayed in a program called *How Things Came to Be.* Drawing from native American myths, American folk tales, and African, South American, and European legends, Vovcsko will tell stories about how the rivers and mountains formed, where the rainbow came from, and why the turtle has a shell. The program will conclude with Vovcsko's own tale of creation, a composite of various

Japanese priestess in the film Shinto

Films by Margaret Mead. Leonhardt People Center, Monday and Tuesday, October 4 and 5, 6:30 to 8:40 P.M. The program on both evenings includes some of Mead's best films, such as *Karba's First Years* and *A Balinese Family.*

For further information and a complete program of events, write to the Education Department, American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Or call (212) 873-1070.

Douglas J. Preston

creation myths from around the world. Especially appropriate for families, the program will take place in the Kaufmann Theater at 11:00 A.M., 1:30 P.M., and 3:30 P.M. Admission is free for members and $2.50 for nonmembers; advance registration is strongly advised. Call (212) 873-1327 for more information.

Inuit Drama

The Tukaq Theater, the first Inuit theatrical group in the world, will perform at the Museum on Wednesday, October 13, at 8:00 P.M. in the Auditorium. *Inuit,* the troupe's best-known drama, is based on ancient Inuit texts, drum songs, and myths. Performed in Greenlandic, it uses masks and rich visual and gestural language to tell the story of the Inuit (literally, "human beings") people, from before the coming of Europeans through the colonization of Greenland and their reaffirmation as a people. Advance ticket reservations are strongly recommended; for ticket prices and information call the Membership Office at (212) 873-1327.

National Film Board of Canada

Omaha Steaks International

Try a little tenderness

Now there's an easy way to make those special occasions truly memorable! Just try a little tenderness.

Candlelight . . . soft music . . . and . . . magnificient, aged Omaha Steaks. Tender, luscious, corn-fed beef with extraordinary flavor. Perfect.

Experts prepare each filet from the finest tenderloins. Their artistry in cutting and aging is your assurance of the utmost in enjoyment.

Your steaks will arrive frozen in a reusable picnic cooler. We guarantee your complete satisfaction. Order today!

Six 6 oz. Filet Mignons, 1¼" thick (reg. $47.50) $29.50
(plus $3.00 shipping/handling)

Save $18.00! Limit 2 per customer. Valid in 48 states until Nov 30, 1982.

James Beard, noted food authority, says: "Omaha Steaks are everything I expect a good steak to be."

FREE WITH YOUR ORDER . The Omaha Steaks Cookbook, filled with easy-to-follow cooking instruction, helpful storing and serving hints, and recipes by James Beard, World Famous Food Authority. Also, a colorful catalog of gourmet treats with a 10% discount on your first catalog order. **Write for FREE catalog and 10% discount coupon only.**

Omaha Steaks International

Use major credit card and

Call Free 1-800-228-9055

In Nebraska phone 0-402-391-3660 collect.

or write to: Dept. 1789, P.O. Box 3300 • Omaha, Nebraska 68103

SAMPLE CATFANCY

A copy of the world's most beautiful and widely read monthly magazine about cats and kittens can be yours for only $1.00 to cover postage and handling. (Each copy sells for $2.00 at the newsstands.) This is a limited time offer so reserve your copy NOW!

Send to: CAT FANCY Dept. NH10, P.O. Box 4030
San Clemente, CA 92672

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: BOOKS-ON-FILE
Box 195 Dept. 72
UNION CITY, NEW JERSEY 07087

Men...Perfect Fit—by Mail!
We guarantee it!

Wright Arch Preserver® Shoes

- Widths AAA to EEE. Sizes 6½ to 16.
- Comfort unsurpassed by any other footwear.
- Top quality standards maintained for 105 years.
- 45 handsome styles in men's footwear.
- Prompt delivery from factory stock of 30,000 pair.
- Guaranteed satisfaction or money back.

Executive Shoes, Dept. 2112, Box 488
Brockton, MA 02430
Send Free catalog of Wright Arch Preserver Shoes.

Name

Address

City State Zip

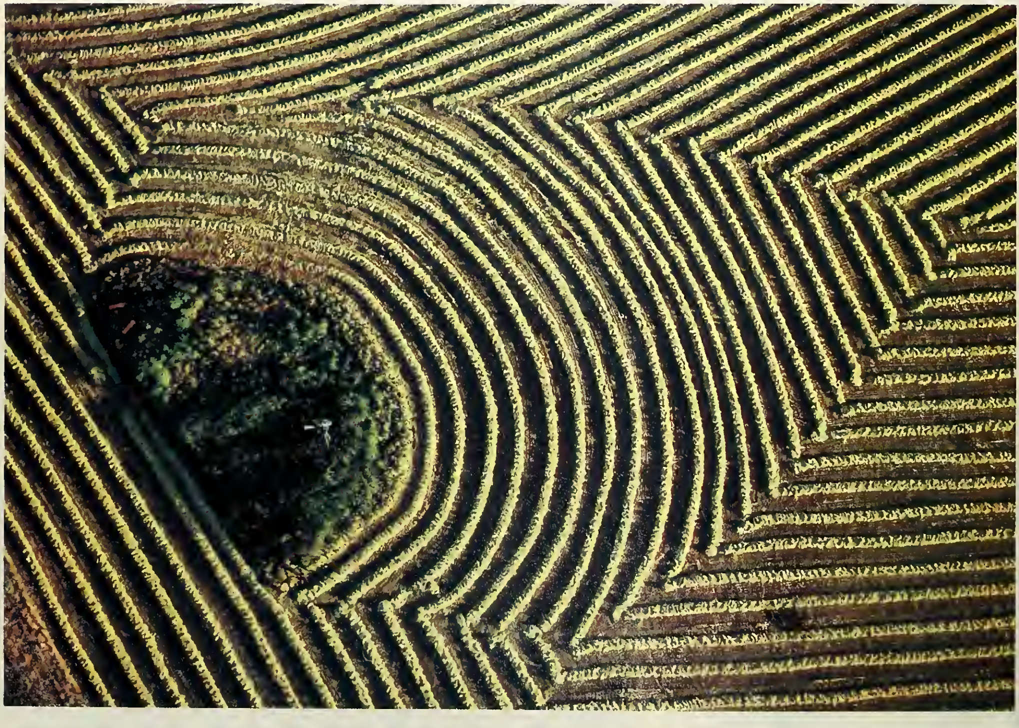
SEND FOR FREE CATALOG

A Lofty View

The Extraordinary Landscape, by William Garnett. *New York Graphic Society Books/Little, Brown and Company, $49.95; 204 pp., illus.*

For more than thirty years William Garnett has been flying over the United States photographing the varied land and water formations that abound in this country. His primary subject is the terrain and the natural forces that affect it—erosion, tides, even volcanic eruptions. When the photographs deal with places where people have left their mark, "the mark," says Garnett, "is a gentle one, consisting mainly of the contouring of land for agriculture. My principal interest is in natural beauty—including not only the spectacular vistas but also the interesting combinations of color and line that can be found in all parts of the country but are sometimes only visible from an aerial vantage point."

Flying in a specially prepared Cessna, Garnett has a unique "God's-eye view" of the earth below, finding beauty in plowed fields, sand dunes, frozen lakes, and mill ponds. Many of the photographs can be admired as beautiful abstractions, but they also record the fabric and texture of



Above: Windrows form contrasting stripes around a windmill in Schellville, California.

frogg

by

Jessica DeStefano

A whimsical, wonderful new work of art in fine porcelain by one of America's most gifted sculptors.

To brighten your every day and delight your family and guests, a magical Frogg holds your favorite fresh or silk flower which you can change as often as you wish.

He's the creation of Jessica DeStefano whose museum and gallery pieces have been hailed as "brilliant" by notable critics coast to coast. Much of her success is the result of a fresh outlook combined with a highly refined skill.

"I don't believe all art should be reserved for complex social or philosophical statements. The frogg has many magical meanings handed down through myth and legend. In creating him as I have, he extends a simple invitation into a world where frogs smile, hold flowers, and fantasies come true."

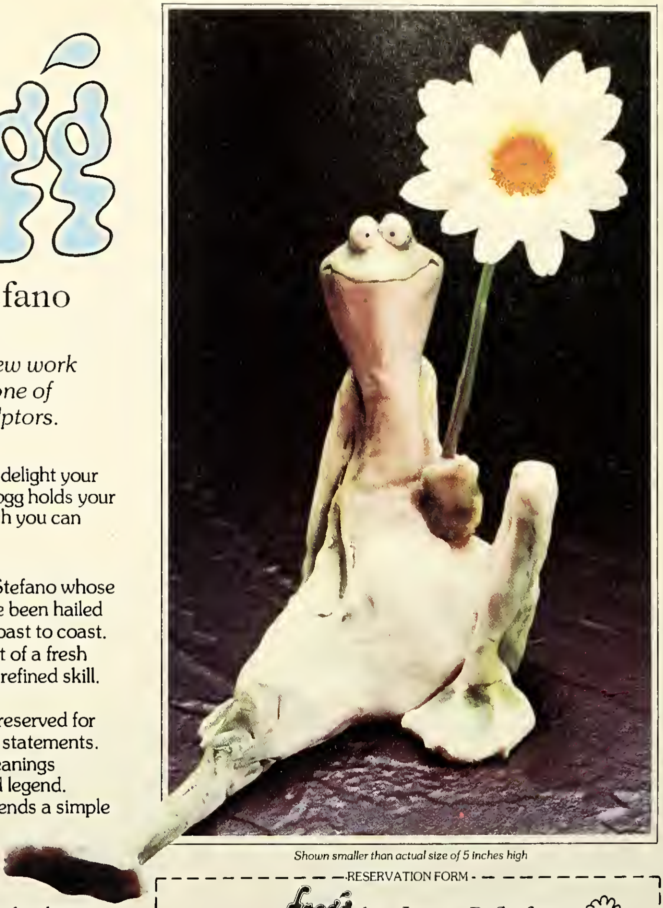
Frogg is individually hand cast in fine bisque porcelain and will be impressed with the hallmark of The Historic Providence Mint, and Jessica's signature.

To reserve Frogg by Jessica DeStefano, you must act promptly. We must have your reservation no later than the validation date shown on the order form.

THE ARTIST

The list of juried shows, awards and one-woman exhibits credited to Jessica is far too lengthy to list. Simply put, she is one of America's best-loved sculptors whose work is eagerly sought by museums, galleries and private collectors. Frogg is the first of her whimsical animal sculpts she has made available to collectors and the first ever to be produced in fine porcelain.

©H.P.M. 1982



Shown smaller than actual size of 5 inches high

RESERVATION FORM

frogg by Jessica DeStefano 640

The Historic Providence Mint
Dept. M NHI-1, 222 Harrison Street
Providence, Rhode Island 02901

Please send "Frogg" by Jessica DeStefano, an original sculpture issued in fine bisque porcelain.

I PREFER TO PAY AS FOLLOWS

☐ DIRECT: Find enclosed my personal check or money order for the full price of $37.50 -- postage included. **(P-30)**

☐ CREDIT CARD: Please charge the full amount of $37.50 to my credit card as marked below:

☐ American Express ☐ Diners Club ☐ Visa ☐ Mastercard

Card No: .... Exp. Date: ....

Signature: ....

Name: ....

Address: ....

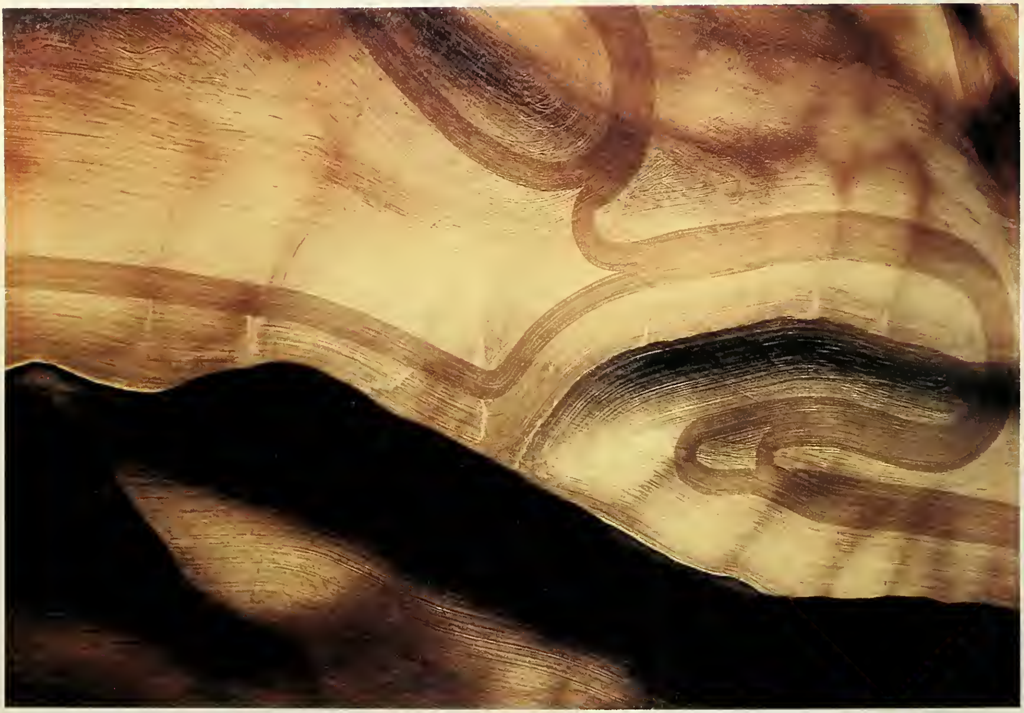
City: .... State: .... Zip: ....

FOR FASTER SERVICE
Call FREE - 1-800-543-3000
OPERATOR #255
Please have credit card number available to speed ordering

HPM™ *Fine Collectibles Since 1907*

Right: Harvest in the Sacramento Valley has left a multilinear pattern on the earth.

Below: Seen from above, plowed hills in Paso Robles, California, take on a new shape.



the land he has chosen to cover: the United States from Maine to Hawaii, from Alaska to Florida.

In his introduction to the book, Ansel Adams notes that "Garnett employs his highly selective eye in directing his camera, in a miraculous performance, to record what flows beneath him as shapes and patterns, values and colors. He pilots his own plane, thereby extending his image-control facility to an extraordinary degree. Literally, his camera has wings. He maneuvers his plane as he would adjust the position of his camera on solid ground, but with added physical freedom.

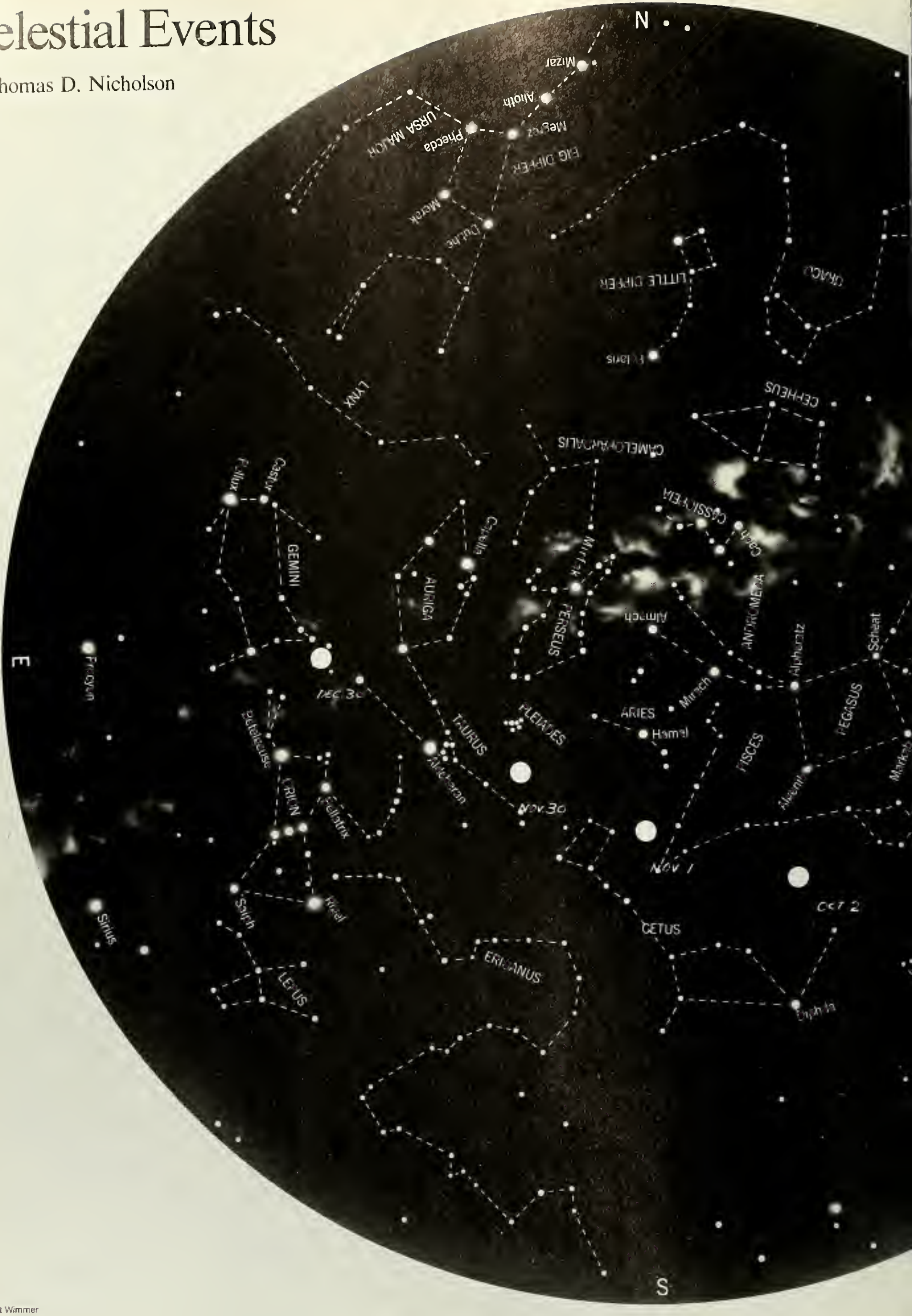
"As a pilot, he can observe the development of his 'decisive moment' when the shapes of the world below join his perceptive eye in the formal expression of his art. His subtle visualizations demand this grasp of anticipation—the essential quality of perception that projects the world in split-second future time and space. This ability is shared by other great photographers, such as Henri Cartier-Bresson and Eugene Smith, working in intimate contact with humanity. There is no posing of an event in action, just as there is no stopping of an airplane in free flight."

Some 165 color photographs make up this patterned portrait of America and there is an introductory text by Garnett, who says, "To fly in a small plane and see the variety of beauty the U.S.A. has to offer is a thrilling experience. Indeed, with such grandeur spread out before me, I often feel guilty that I am up there alone." This book should assuage his guilt.

Carol Breslin

Celestial Events

by Thomas D. Nicholson


N
E
S
Mizar
Alioth
Megrez
Phecda
URSA MAJOR
BIG DIPPER
Merak
Dubhe
LITTLE DIPPER
Polaris
DRACO
CEPHEUS
LYNX
CAMELOPARDALIS
CASSIOPEIA
Caph
Pollux
Castor
GEMINI
Capella
AURIGA
Mirfak
PERSEUS
Almach
ANDROMEDA
Alpheratz
Scheat
PEGASUS
Markab
Algenib
Mirach
ARIES
Hamal
PISCES
PLEIADES
TAURUS
Aldebaran
Procyon
Betelgeuse
ORION
Bellatrix
Rigel
Saiph
Sirius
LEPUS
ERIDANUS
CETUS
Diphda
DEC 30
NOV 30
NOV 1
OCT 2

Helmut Wimmer

All Month There is not much of distinction about the planets in October. But as they routinely go about their business (which, among other things, is revolving around the sun), they inevitably move into the part of the sky where the sun itself is located. When that happens, their time above the horizon coincides with daylight, so that they are not distinguishable in the sky no matter how bright they are (Venus is an occasional exception). This October all but one of the five planets ordinarily bright enough to be seen without a telescope will suffer that fate (as far as planet watchers go). The one exception is Mars, still an evening star moving swiftly from the constellation Ophiuchus into Sagittarius.

Vega
Lyra
Cygnus
Delphinus
W
Enif

October 1: Almost full, the big, fat, waxing gibbous moon is in Pisces, very near the vernal equinox, where the sun is stationed on the first day of spring. Above the horizon at sundown, the moon fills the earth and sky with light until dawn.

October 2: Today's moon is the harvest moon, the name given to the full moon that occurs closest to the date on which autumn begins. When the full moon is near the vernal equinox and is rising, the lunar orbit is inclined to the horizon by the minimum angle, which tends to minimize the daily retardation (or lag) in the time of moonrise. This creates the appearance of a full or almost full moon in the sky all night long for several successive nights. The bright, early evening moonlight as an aid in "bringing in the crops" is the explanation for the name harvest moon.

October 6: The gibbous moon is now waning, rising about 8:00 P.M., EST. Tonight, the Pleiades (Seven Sisters) appear as a fuzzy patch of dim stars to the right and above the moon.

October 8: The perigee moon (nearest the earth) enters Gemini, where you will see it tonight from moonrise on.

October 9: Still in Gemini, the moon is at last-quarter, passing below the "twin" stars Pollux (the brighter) and Castor, above and to its left.

October 12–13: The shrinking crescent moon is still visible in the dawn sky of both mornings. The star below and to the moon's left early on the morning of the 12th is Regulus, in Leo. The moon passes above Regulus that evening when both objects are below the horizon.

October 16: The new moon is in Virgo, near Spica.

October 17: Mercury is at the greatest distance to the right of the sun (greatest westerly elongation), placing it in the best position for viewing as a morning star.

October 18: The young crescent moon is in conjunction with Jupiter, but barely thirty-six hours after new moon. There is a chance of seeing them before they set, low in the east during twilight, but it will require extremely clear skies. Saturn is in conjunction with the sun and becomes a morning star as the sun moves past it from right to left.

October 19: The young crescent moon of the new cycle should be visible tonight after sundown. The reddish star below to its left as they set is Antares in Scorpius.

October 21: Mars is below the crescent moon tonight. Since the moon sets before midnight, it will not interfere with viewing the Orionid meteors. This shower, producing up to twenty-five meteors per hour, reaches maximum at about 1:00 P.M. on the 21st, so viewing may be equally good after midnight on the 20th and the night of the 21st.

October 24: The moon is at first-quarter phase tonight, rising among the stars of Capricornus near the westerly apex of the bikini-shaped group of stars that identifies the constellation.

October 29: The waxing gibbous moon moves into line with the eastern edge of the Square of Pegasus.

October 31: Communities that use daylight time return to standard time this morning (clocks are set back one hour). Aries is the home of the moon tonight. Above the horizon at sundown, the moon sets with Aries before dawn.

The fall Sky Map shows the sky for the months of October, November, and December from latitude 40° north at the evening hours given below. To use the map, hold it vertically in front of you with the north (N) at the bottom and match the lower half of the map with the stars you see when you face the north. As you face in other directions, roll the map to bring the corresponding compass direction to the bottom of the map.

The stars move west continuously during the night. By morning (before dawn), stars on the western half of the map will have set, those on the eastern half will have moved into the west, and new stars (those of the spring evenings) will have risen in the east. The map represents the sky at about 2:00 A.M. on October 1; 1:00 A.M. on October 15; midnight on October 31; 11:00 P.M. on November 15; 10:00 P.M. on November 30; 9:00 P.M. on December 15; and 8:00 P.M. on December 31. Add one hour for daylight time. The map can be used for an hour or more before and after the times given.

THE MARKET

Art

A CHILD'S KEEPSAKE . . FAMILY HEIRLOOM. Natural wood toy train—Engine, caboose and letter cars spell any name! Send 25¢ for details. McCay's, Route 1, Lebanon, VA 24266

AMERICAN INDIAN CRAFTS: Southwest Indian pottery, baskets, rugs, kachinas. Northwest Coast Indian masks, totems, graphics, Eskimo sculpture. No catalogue. One-of-a-kind pieces, individually photographed. Priced $100/up. Photos and data available. Specify interests. Box 5896, Sherman Oaks, CA 91413 (213) 789-2559

Pre-Columbian Collectibles!

PARADISE OF TLALOC (200 B.C.-A.D. 900), the Mexican rain God of the Aztecs—only one of many original serigraphs and rubbings of Aztec and Maya ruins! Complete color catalog $2 (deductible with order).

BERNARDO

2400 Westheimer Suite 108W (NH10)
Houston, TX 77098

CANADIAN WOODLAND INDIAN Original Paintings. Grant, 404-8th Street South, Kenora, Ontario, Canada P9N 1R3

FEDERAL/STATE WATERFOWL STAMP Print Specialists. Excellent inventory. Write or call (503) 343-9255 for informative newsletter. d'Lou Wildlife Galleries, 2769 Emerald, Eugene, OR 97403

IROQUOIS WOLF FALSE FACE, $100, request photo, also Iroquois stone carvings, McCoy Imports, Liberty, NY 12754

PLAINS INDIAN ART & ARTIFACTS: Free catalogue shows painted shields, mounted trophy buffalo skulls, war arrows, peace pipes, chokers, breast plates, war clubs, horse dance sticks, star quilts and more. Exclusive source. Handmade with traditional tools and authentic materials. Many have interesting stories to tell from Cheyenne, Sioux and Blackfoot heritage. Collector's items, unique gifts and stunning decorations. Write or call: Prairie Edge, P.O. Box 8303, Dept. K, Rapid City, South Dakota 57701 (605) 341-3620

RUBBER STAMPS of nature. $1.30 for catalogue of your favorite wildlife. Nature Impressions, 1007 Leneve Place, El Cerrito, CA 94530

WILDLIFE ART, by Robert Bateman and other world-famous artists, is available as high-quality, limited edition prints. For a list of his work, along with other well-known western and wildlife artists, including Calle, Doolittle, McCarthy, Vietor and Frace, write: Gary Milburn, 4431 N Drake, Chicago, IL 60625

Back Numbers

NATIONAL GEOGRAPHICS 1888-1982, issues Book Publications, Collectors Items, Send Wants Buxbaum Geographics, Box 465-NH, Wilmington, DE 19899

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHV, 84 Fifth Avenue, New York, NY 10011

Books

BOOKFINDING LIBRARIANS locate any subject or title, 150,000 different titles in stock, indexed by author, subject & title. PAB, 2918 Atlantic Avenue, Atlantic City, NJ 08401 or (609) 344-1943

PUBLISHERS' OVERSTOCKS

All publishers — all subjects: art, history, biography, fiction, and much more. The most complete catalog of bargain books available anywhere! Write for your FREE copy:

Hamilton, 98-55 Clapboard, Danbury, CT 06810

YESTERDAY'S BOOKS LOCATED, no obligation. Out-of-State Book Service, Box 3253J, San Clemente, CA 92672 (714) 492-2976

Collectors Items

BIRDS ON POSTAGE STAMPS from many countries. 25 different 35¢ or 50 different 65¢. George Ford, P.O. Box 5203-N, Gulfport, FL 33737

Correspondence

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin, West Germany

ORIENTAL WOMEN SEEK CORRESPONDENCE for cultural exchange, language practice, friendship. Asian Exchange, Honokaa, Hawaii 96727

PENFRIENDS-ENGLAND-USA. Make lasting friendships through correspondence. Send age, interests. Free reply. Harmony, Box 89NH, Brooklyn, NY 11235

SCANDINAVIAN LADIES, SINCERE, seek correspondence for meaningful relationships. Details: Scannaclub, Dept. H6, Box 4, Pittsford, NY 14534

SINGLE BOOKLOVERS gets cultured persons acquainted. Nationwide. Established 1970. Write Box AE, Swarthmore, PA 19081 or call (215) 566-2132

Education

LEARN/PLAY CHESS with more flair . . with Color/Coded Pieces (patented). Send SASE for poster/info: Iris, P.O. Box 262, Newbury, Ohio 44065

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Big Pay! Transportation! Newest Handbook, $2.00 Australian International, Box 19107-RX, Washington, DC 20036

ENVIRONMENTAL OPPORTUNITIES—Monthly bulletin lists environmental job openings throughout the U.S. Free details: EOV, P.O. Box 450, Walpole, NH 03608

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RX, Washington, DC 20036

OVERSEAS JOB—68 COUNTRIES! Hiring now! Paid fare. Computerized reports $2.00. Jobworld, Box 681-NH, Cypress, CA 90630

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . Intermountain 4Y, 3506 Birch, Cheyenne, WY 82001

TEACH HERE—TEACH ABROAD: School, College openings; USA $5.95; Abroad $5.95. Placement sources: USA $4.95; Abroad $4.95. EISF, Box 662, Newton, Massachusetts 02162

Financial

GET CASH GRANTS—FROM GOVERNMENT. (Never repay). Also, cash loans available. All ages eligible. Complete information, $2 (refundable). Surplus Funds-NH, 1629 K St., Washington, DC 20006

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Australia. Sampler: 4/$2.98. Free Brochure. Multinewspapers, Box DE-200, Dana Point, California 92629

Gourmet Interests

15 EXQUISITELY, DIVINE gourmet recipes from world famous restaurants $2 SASE. "Gourmet Recipes", Box 240, Wausa, Nebraska 68786

HAWAIIAN TEN COURSE DINNER RECIPE delicious easy island favorites, $3.00, 45087B Waikalua Rd., Kaneohe, Hawaii 96744

PIES Cranberry-Orange & Sweet Potato. Easy, unusual and delicious. SASE $2.00. Gregory, 5 Spencer St., Woodmont, CT 06460

Government Surplus

GOVERNMENT SURPLUS! Millions of items (Including Jeeps) . . low as 1¢ on dollar! Most complete Directory available—$2.00. Disposal, Box 19107-RX, Washington, DC 20036

JEEPS, CARS, pickups from $35. Available at local Government Auctions. For Directory call (805) 687-6000 Extension 910. Call refundable.

Merchandise/Gifts

BEAUTIFUL CROSSES OF STONE, Polished, Ringed, ready for Chain. ¾ inch—$2.25, 1—2.50, 1¼—2.75, 1½—3.00, 1¾—3.25, 2—3.50. Postpaid. Archies, P.O. Box 444, Rossville, GA 30741

DOG TAGS FOR YOUR BAGS, cameras, equipment, etc. 4 lines—15 spaces each, 3 tags $11.99. NYS add tax. CMA, 1742 Second Ave., Dept 200P, NYC 10028. Free brochure #P, (212) 249-1381

DOMINICAN AMBER! Graduated nugget necklaces. Specify clear or varigated. 17" for $32. 22" for $48. Check, M/O, M/C or Visa (include expiration date, account and number, and signature). Amber Caribbe, P.O. Box 1375, Kingston, PA 18704

FREE LUGGAGE CATALOG

Deluxe quality at down-to-earth prices. Wide assortment of soft Cordura® airline carry-ons, pullmans, ski, tennis, golf, camera, barrel and garment bags.

Bob Finch
17 Barstow Road
Great Neck, NY 11021

FREE CRYSTAL CATALOGUE. Sparkling pendants, earrings, window prisms crafted from 32% full lead Austrian crystal. Free shipping. Give a rainbow for the holidays! For free catalogue: Waterbabies Crystal, NH-10, Suite 41, 2067 Broadway, NYC 10023

NATURAL HISTORY MAGAZINE

SAVINGS CERTIFICATE

For *FOR THE SUM OF 9 DOLLARS*

This savings certificate saves you $9.00 off the single copy rate for 1 year on new subscriptions or renewals (12 beautiful and thought-provoking issues) of NATURAL HISTORY magazine, including membership in the American Museum of Natural History and all the benefits that go with it. As soon as we receive your order, we'll start your subscription and send your membership card.

☐ **YES,** Please send me a full year of Natural History at the low rate of $15 for 12 issues including Museum membership

☐ I want to save more. Send me 2 years of Natural History (24 issues) which includes membership for only $26 (a $22 savings off the single copy price).

☐ New ☐ Renewal

Send gift to: J562

Name ______ (please print)
Address ______
City ______
State ______ Zip ______
☐ Payment enclosed ☐ Bill me later
Charge my ☐ Visa ☐ MasterCard
☐ American Express
☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
Account number

Name ______ (please print)
Address ______
City ______
State ______ Zip ______
Gift card to read ☐ 1 year $15 ☐ 2 years $26
Signature ______
Moneyback guarantee if not satisfied.

Please add $5 per year for postage outside the USA. Payment must be included.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

POSTAGE WILL BE PAID BY ADDRESSEE

NATURAL HISTORY

P.O. Box 4200
Bergenfield, N.J. 07621

Vivaldi's 'Mandolin Concerto' Is Yours For Only $1.00

with your FREE-NO PURCHASE-OBLIGATION membership

Vivaldi's *Mandolin Concerto in C Major* is a work of such captivating beauty and universal appeal that once it is heard, the listener is almost compelled to hear it again and again. This fact was experienced by hundreds of thousands of viewers of the Academy Award winning movie *Kramer vs. Kramer*, in which this Mandolin Concerto was featured.

A brief movement from a Vivaldi mandolin concerto was played frequently for one week on a "pop" radio station. The reaction of the station's listeners was astonishing—after this exposure the disc sold some 80,000 copies! This is the record that was played by the station!!

Now you, too, can enjoy a copy of this out-of-this-world recording for only $1.00 ($2.00 for cassette) along with your FREE-NO OBLIGATION membership in the Musical Heritage Society.

GET "SELECTIONS FROM OUR MASTER CATALOG" FREE!

The Musical Heritage Society has been acknowledged as "the Nation's treasure house of obscure as well as familiar classical music."

With your introductory recording, we will include "Selections from Our Master Catalog" containing records and cassettes covering every musical period, carefully chosen from our collection of almost 3,000 records and cassettes.

The Musical Heritage Society issues each year about 200 new recordings of the music of such great masters as Albinoni, the Bachs, Beethoven, Berlioz, Buxtehude, Charpentier, Corelli, Couperin, Gluck, Handel, Haydn, Lully, Monteverdi, Mozart, Pergolesi, Purcell, Scarlatti, Schubert, Telemann, Torelli, Vivaldi, and many others. Its recordings cover all musical periods: Medieval, Renaissance, Baroque, Rococo, Classical, Romantic, and Modern. Over 200 of its recordings have been honored with the coveted GRAND PRIX DU DISQUE and other international awards.

Most of the Society's records are of works recorded FOR THE FIRST TIME! Manufactured to the highest quality standards of which the recording industry is capable, the Society's records are perhaps the finest in the country.

HOW THE SOCIETY OPERATES

The Society's recordings are not sold in stores. They are offered directly through the MUSICAL HERITAGE REVIEW magazine at three-week intervals. As a member, you'll enjoy substantial savings. Member prices are $4.95 per LP or cassette, plus postage and handling (deluxe-boxed editions and digital recordings are slightly higher).

When the Society receives your request, it sets up an account in your name and begins sending your free one-year subscription of the MUSICAL HERITAGE REVIEW for your edification and delight. There is NO PURCHASE OBLIGATION and you may discontinue the complimentary subscription at any time. As a subscriber, outstanding selections will be scheduled for shipment to you from each issue—but there is no obligation to accept them...order only those you want when you want them!

A special response form will be enclosed with each Review...and you may use it to order or reject any selections simply by mailing it by the date specified. And if you want only the scheduled selections, you need do nothing—they will be shipped to you automatically. What's more, you'll have at least 10 full days in which to make your decision—if you ever have less time than that, just return the special selections at our expense, for full credit.

Unforgettable Moments of Musical Pleasure Await You—Send for this Record or Cassette and your Free Society Membership Today!

All applications are subject to review before membership is granted.

MUSICAL HERITAGE SOCIETY *0532703
14 Park Road, Tinton Falls, N.J. 07724

Ladies and Gentlemen of the Society:
Please send me Vivaldi's MANDOLIN CONCERTI along with my FREE copy of "Selections from Our Master Catalog." You may enter my subscription to the Society's recording program and set up an account in my name. However, it is understood that I may cancel at any time, and there is absolutely no purchase obligation on my part. My payment for this order is enclosed.

SEND "MANDOLIN CONCERTI" IN THIS TYPE OF RECORDING:

☐ Record #1100, $1.00 ☐ Cassette #2217, $2.00

☑ #9037 "Selections From Our Master Catalog"

NAME ____________________

ADDRESS ____________________

CITY ____________ STATE ______ ZIP ________

Send my FUTURE selections in: ☐ Records ☐ Cassettes

OFFER OPEN TO NEW MEMBERS ONLY
Offer Valid Within the Connecting United States Only

FREE KIT CATALOGUE. Over 100 do-it-yourself products. Value prices. Write Woodcraft, Dept K04, Box 4000, Woburn, MA 01888

HAND CARVED MAHOGANY, Mayan design bowls, plaques, owls, boxes, office items, tables, free brochure. Artisan Originals, Rt 1, Box C-24, Flat Rock, AL 35966

IN THE AMERIIAN FOLK-ART TRADITION. TIE RACK Solid handcrafted Oak base, (20″ × 2″ × ¾″), rich natural color with 36 matching 1-⅞″ Maple pegs. Holds 36 ties. Easily screws into wall or closet door. Handsome and useful Money back guarantee. $11.95. Rhodes Trading Company, P.O. Box 206, Lawrence, NY 11559

1-800-334-8174 Puts you in contact with America's leading furniture mfg's at superlative savings. Barnes & Barnes, Library for Fine Furniture, 651 S.W Broad St., Southern Pines, NC 28387. In NC call (919) 692-3381

TRAVEL SECURITY DEVICE—smoke, fire, intruders. Free brochure #N, (212) 249-1381. CMA, 1742 Second Ave., Dept. 200N, NYC 10028

Miscellaneous

ANIMAL-FREE PRODUCTS using natural ingredients to provide healthful alternative to animal exploitation. Cosmetics, shampoos, household products. Free catalogue. Amberwood-Q, 125 Shoal Creek Road, Fayetteville, Georgia 30214

ILLUSTRATED HERB CATALOGUE: Complete culinary/medicinal selection. $1.00 Refundable. Herbal Effect, Box 6, Dept B, Carmel Valley, CA 93924

READ THE HEART-WARMING STORY of a tiny, emotionally disturbed laboratory gibbon ape rehabilitated by loving care. Send $1.00 to International Primate Protection League, P O Drawer X, Summerville, SC 29483

VACATION HOME COOPERATIVE. Six middle-aged families seek additional members to share, cooperatively, historic mansion for weekends and vacations on year round basis. 25 acre estate, Recreation, Swimming 100 miles north of NYC. Call: A.M. (212) 947-7600 (Mr. Bell) P.M. (212) 543-5086

Music

RECORDS-TAPES! Discounts to 73%. All labels; no purchase obligations; newsletter; discount dividend certificates. 100% guarantees. Free details. Discount Music Club, 650 Main Street, P.O. Box 2000, Dept. 25-1082, New Rochelle, NY 10801

Personals

MEET SINGLES Mexico, Orient, Europe, Australia. Free information. Write: International, Box 1716-NH, Chula Vista, CA 92012

SPECIAL MAGAZINE for international friendship, free details. "World Contact" International, P.O. Box 2464, D-2350 Neumuenster, W Germany. Attn: Toni Sakalautzky

Photographs

THE FLYING EAGLE: Finest laser color reproductions of the ultimate Bald Eagle photograph. 12″ × 20″, $15. Beautiful Eagle cards, $2. Dr Hunter, Box 10-888, Anchorage, Alaska 99511

WOLF PHOTOS, Slides, postcards. Free brochure. J. Lidle, P.O. Box 112, Clifton Heights, PA 19018

Optical

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923 Alignment performed on our U.S. Navy collimator Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St, West Coxsackie, NY 12192 (518) 731-2610

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON, Optolyth binoculars, telescopes and accessories. Send stamp for discount list Specify literature desired. Large stock. Orders filled postpaid day received Birding, Box 5N, Amsterdam, NY 12010

Real Estate

FREE! BIG Fall-Holiday Catalogue! Over 5,400 country properties described, pictured! Land, farms, homes, businesses, recreation, retirement values! Selected best of hundreds of offices All Across America! Strout Realty, Inc., Executive Park Tower, Dept. 5390, Albany, NY 12203 Call toll free: 1-800-641-4266; in Missouri call collect (417) 862-4402

FREE CATALOGUE. Describes and pictures farms, ranches, acreages, businesses and town and country homes from coast to coast United Farm Agency, Inc., 612-U W. 47th St., Kansas City MO 64112. Call Toll-Free: 1-800-821-2599; MO res. call Toll-Free: 1-800-892-5785

GOVERNMENT LANDS . FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00 Lands, Box 19107-RX, Washington, DC 20036

"HOME BUYER'S INSPECTION GUIDE" Save time and Money! A must for the Home Buyer. $4.00. Realty Services, Dept. NH, Box 382, Lynbrook, NY 11563

Rental

ST. JOHN, VIRGIN ISLANDS apartment for two. Vacation: swimming, snorkeling, exploring National Park. $350 weekly. Barsel, Box 114, St. John, U.S.V.I. 00830

TOBAGO, PRIVATE BEACH COTTAGES on working cocoa plantation. Swimming, snorkeling, fishing from your front door. Bird watcher's paradise. Brochure. Charles A. Turpin, Charlotteville, Tobago, West Indies

Resorts

CARIBBEAN HIDEAWAY. Very small, very special hotel tucked into a 30 acre plantation on the island of Bequia, St. Vincent Grenadines, W.I. Ten rooms, pool, beautiful beach, snorkeling, hiking, photography, birding, tennis. Write or call: Spring on Bequia, Box 19251, Minneapolis, MN 55419 (612) 823-1202 or your travel agent

JUNGLE VACATION in the Talamanca Rainforest. Superb birding, plant and insect hunting. Riding and hiking trails; guides. Weekly rates $225.00 single; $350 double. M E. Snow, Apartado 73, 7200 Siquirres, Costa Rica

Tours/Trips

ADIRONDACK WILDERNESS SKI TOURS: Enjoy the exhilaration and beauty of a northern winter in the company of expert instructor/guides. Cross-country ski vacations are five days, limited to 10 guests, geared to all levels of ability. Daily excursions into "forever wild" Forest Preserve. Evenings spent in cozy lodge enjoying hearty meals, good company, and fireside programs featuring Adirondack naturalists, photographers and conservationists. Write: Adirondack Ski Tours, McMaster Rd , Saranac Lake, NY 12983 Call (212) 546-9202

ADVENTURES WITH WILDLIFE—Whale Watch cruises with gray whales, humpbacks and even blue whales. African photo safaris viewing gorillas in Rwanda, wildlife and birds in Kenya, Tanzania, Zambia, Botswana and Madagascar New brochure with 24 trips Adventures International, Dept NC, 4421 Albert, Oakland, CA 94619

AFRICA: AFFORDABLE ADVENTURES. Our own, comfortable, weekly Jet allows fabulous Kenya experiences, at incredible prices, European quality. Example: 17 days $1796, All Included (from USA). Wildlife, People, Safari, Indian Ocean Adventure. Also: Madagascar (Living Fossils), Rwanda (Gorillas), Tanzania, Botswana, Namibia, etc. Request Prospectus: Forum Travel International, 2437 Durant, Berkeley, California 94704 (415) 843-8294

ALASKAN WATER ADVENTURES. Kayaking, Rafting, Birding in Prince William Sound and Copper River Basin. College credit available. Open Door. Box 1185N, Cordova, Alaska 99574 (907) 424-7466

BAJA CALIFORNIA GRAY WHALE EXPEDITIONS on the Qualifier 105 with expert naturalists as leaders. December through March. Elephant seals, sea lions, marine birds, desert island plants, wildflowers and whales for an outstanding natural history experience. Write for free brochure to Nature Expeditions International, Dept. 22NH, 599 College Avenue, Palo Alto, CA 94306

BAJA WHALE-WATCHING 5 days/4 nights, Scammons Lagoon whale-watching camp, Feb. 14-19, $774. Contact Wilderness: Alaska/Mexico, Dept. NH, 5119½ 27th N E., Seattle, WA 98105 (206) 522-5315

INDIA-NEPAL
Jan. 8-31, 1983

Experience exotic wildlife and culture with Himalayan Naturalist and co-author of *Birds of Nepal*, **Bob Fleming, Jr.** All inclusive price from NYC $4558. Other tours include China, Arizona, Colorado.
Write: **WORLD NATURE TOURS, INC.**
P.O. Box 693d, Silver Spring, MD 20901 (301) 593-2522

BECOME A SPARETIME TRAVEL AGENT, detailed guidebook explains how, commissions, travel benefits, $3.95 SAV Travel, Box 571-NH, Hicksville, NY 11802

DISCOVER BAJA! Join experienced naturalists and crew for leisurely ocean-going explorations of the wilderness islands and lagoons of Baja's Pacific coast, the Sea of Cortez, or Mexico's tropical west coast Enjoy whales, seals, dolphin, birding, fishing, nature study, island hiking, and more! Excellent photo opportunities. Small groups, relaxed pace. Trips 4-10 days year-round for individuals or groups. Color brochure: Pacific Adventures Charter Service, 2445 Morena Blvd , Suite 200H, San Diego, CA 92110 (714) 275-4253

DISCOVER BERMUDA—A personal journey into the natural environments of an enchanting, gentle world. June 18, 1983. Blue Sky Adventures, Natural History Vacations, Oak Ridge, NJ 07438

EXPERIENCED NATURALIST helps you explore wild Africa, Amazon, Galapagos, and much more. Numerous whale study cruises. Brochure: Biological Journeys, 1876B Ocean Drive, McKinleyville, CA 95521

GALAPAGOS HIKING AND SAILING EXPEDITIONS. Small groups-Charters. 8-25 Days. 1983 Departures: April 28, July 21, July 28 Options: Ecuador, Peru, Machu Picchu, Diving, World Inca Floats, Inc., 5982 Balboa Dr , Oakland, CA 94611 (415) 339-9095

INCAS, MAYAS & IGUANAS: Legendary Peru, Ecuador. Fascinating Galapagos, Amazon, Costa Rica, Brazil, etc. Small Groups/Individuals. Forum Travel, 2437 Durant, Berkeley, California 94704 (415) 843-8294

GALAPAGOS ISLANDS. Economic tours from $1666 including airfare. 4, 5, 8, & 15 days Galapagos, all meals. Options, mainland Ecuador, Amazon, Cuzco/Machu Picchu. University credit available. Joseph Colley, Last, Inc., 43 Millstone Rd , Randallstown, MD 21133. (301) 922-3116

Unusual India & Nepal

Trekking (walking) expeditions to the foot of Mt Everest & Annapurna Wildlife safaris in search of rare Asian birds and mammals. Explorations of remote Bhutan, Sikkim, Ladakh and tropical Sri Lanka 10 to 35 day programs from $670.00 + airfare Free Brochures

Himalayan Travel, Inc.

P.O Box 481-NH
Greenwich, CT 06830
(203) 622-0055 Toll Free (800) 243-5330

LEGENDARY CULTURES, FASCINATING NATURE: Latin America, Africa, Asia, Egypt, Europe. Conventional, Adventure and Hiking programs. Small Groups/Individuals. Request summary, specifying interests. Forum Travel, 2437 Durant, Berkeley, California 94704 (415) 843-8294

NEW ZEALAND WALKABOUT. Escorted nature and hiking tours featuring New Zealand's scenic National Parks, plus the Milford Track Pacific Exploration Co., Box 3042-N, Santa Barbara, California 93105 (805) 687-7282

READY TO TRAVEL? Plan ahead with finest maps! $1.00 Catalogue. Eagle Eye, Box 751-N10, Paonia, CO 81428

SEEKING ADVENTURE, DISCOVERY, LEARNING? Request free details. Unique & Exotic Travel Reporter, P.O. Box 98833-N, Tacoma, WA 98499

THE INN WAY by Margaret Zellers Compact, comprehensive guidebooks about small, family-operated hotels in Austria, Switzerland or Caribbean. Specify area. Send $4.95 per book plus $1.50 postage/handling to Geomedia, Southport, CT 06490

200 YEAR OLD SPANISH RANCH. Unexcelled riding, great birding (200 species), wildlife. Delightful dining, sunshine, quiet. Adjacent to Kitt Peak Observatory, Papago Indian Reservation, Mexican border. Rancho de la Osa, Box 1, Sasabe, AZ 85633

UNIQUE TRAVEL BOOKS! Exploration, nature/wildlife, maps, languages. Free catalogue! Wayfarer Books, Box 1121-NJ, Davenport, Iowa 52805

RATES AND STYLE INFORMATION

The following new rates are effective with the January 1983 issue.

$2.00 per word; 16 word ($32) minimum. *Display classified* is $200 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY to: The Market, NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024 Please include your personal address and telephone number, issue preferred, and suggested heading Deadline—1st of the month, two months prior to cover date (the January issue closes Nov. 1). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

The Questers Program for Fall & Winter 1982

Stimulate your mind on a Questers nature tour.
We search out the plants and animals, birds and flowers.
and explore rain forests, mountains and tundra, seashores,
lakes and swamps. There is ample time to photograph, absorb, reflect.
Naturalist guides, small tour parties, first-class accommodations.

Worldwide Nature Tours Fall & Winter 1982 Departures

The Americas

Everglades: 11 days, Nov. 4, Apr. 7 • Hawaii: 15 days, Oct 10, Dec 19, Feb 10, Mar 24 • Southern Mexico: 14 days, Dec. 19, Feb 13 • Panama & Costa Rica: 14 days, Dec 18, Feb. 12 • The Amazon: 17 days, Oct. 10, Nov. 14, Jan 9 • Ecuador and Galapagos: 15 days, Oct 28, Dec 30, Feb. 10 • Peru: 17 days, Nov 6 • Patagonia & Tierra del Fuego: 21 days, Nov. 6, Jan. 10 • Trinidad & Tobago: 11 days, Nov 8, Mar 7.

Asia & Africa

The Himalayas: 23 days, Oct. 7, Mar 17 • India: 23 days, Oct 30, Jan 29 • Sri Lanka: 18 days, Nov 19, Feb 18 • Kenya: 23 days, Oct 21, Feb 3

Australasia

Australia & New Zealand: 30 days, Oct 2, Feb. 12 • New Zealand & Milford Track: 22 days, Nov. 12, Feb. 11.

New & Special Tours

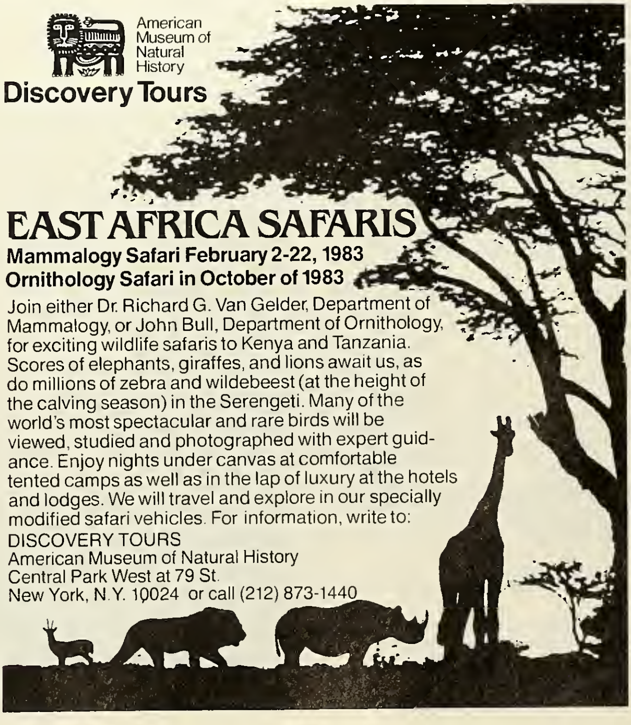
We will also be offering in 1983 a number of new and special tours. Among them are

- New Guinea
- Walking in the Foothills of the Western Himalayas
- Japan
- Madagascar/Réunion/Mauritius
- Okefenokee Swamp & Georgia's South Coast

Write or call today for your complimentary Directory of Worldwide Nature Tours and to be placed on our mailing list. If you are interested in a particular tour, please request its Detailed Itinerary

QUESTERS

Questers Tours & Travel, Inc.
Dept. NH, 257 Park Avenue South
New York, NY 10010 • (212) 673-3120



American Museum of Natural History

Discovery Tours

EAST AFRICA SAFARIS

Mammalogy Safari February 2-22, 1983
Ornithology Safari in October of 1983

Join either Dr. Richard G. Van Gelder, Department of Mammalogy, or John Bull, Department of Ornithology, for exciting wildlife safaris to Kenya and Tanzania. Scores of elephants, giraffes, and lions await us, as do millions of zebra and wildebeest (at the height of the calving season) in the Serengeti. Many of the world's most spectacular and rare birds will be viewed, studied and photographed with expert guidance. Enjoy nights under canvas at comfortable tented camps as well as in the lap of luxury at the hotels and lodges. We will travel and explore in our specially modified safari vehicles. For information, write to:

DISCOVERY TOURS
American Museum of Natural History
Central Park West at 79 St.
New York, N.Y. 10024 or call (212) 873-1440

Cotton
Flannel Sheets
& Natural Fiber Wearables

The Natural Fibers Catalog® now offers the widest and best-ever selection of wonderfully soft and warm things to sleep under or wear, including—

Our famous cotton flannel sheets and pillowcases in 12 solids, a stripe, a print and a check. **Wool and cotton blankets,** luxurious **comforters** filled with down.

In wool, cotton or silk: **long underwear** for men and women, delicate **lingerie from Switzerland and Italy,** beautifully fashioned **tights.** Plus—**sleepwear** of swiss cotton knit or flannel for men and women.

Children love our cloud-soft cotton or wool **long underwear, tights and socks,** cotton and flannel clothing, cotton turtlenecks, sweaters, plus wool hats, mittens and scarfs—and so much more, all of superb quality, all in the full-color pages of Garnet Hill's

The Natural Fibers Catalog®

garnet hill

662A Main St., Franconia, N.H. 03580

$1 enclosed. Enter my 2 year subscription to The Natural Fibers Catalog®. Include flannel swatches with first issue.

Name ______

Address ______ Zip ______

Visit our shop in Franconia! Open Mon.-Sat.

LEARN PROFESSIONAL PHOTOGRAPHY at home.

Would you like to see your pictures in magazines like this? For 70 years, NYI has trained amateurs to take professional pictures—pictures that get published, win prizes, even lead to a new career. If you love photography, NYI can make it happen for you too.

You'll learn at home in your spare time, with our new "Voice-on-Tape" method that guides you easily through magnificent portfolio-size lessons, illustrated by salon-quality photos of world-famous masters. A remarkable course at surprisingly low cost. Call or send for free informative booklet. No obligation.

Mail coupon OR CALL TOLL FREE 800-453-9000

Yes! Send me the free color booklet about the NYI Course. No obligation. No salesman will call.

Name ______

Address ______

City/State/Zip ______

☐ Under 18, check here for special information.

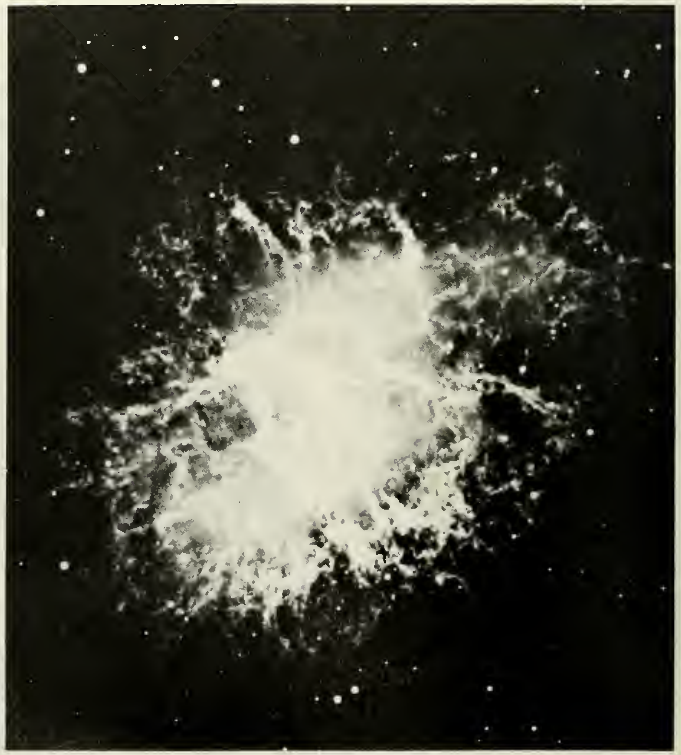
New York Institute of Photography
Dept. N102 880 Third Ave., N.Y., N.Y. 10022

Origin of the Crab Nebula

What kind of star erupted to produce this well-known supernova?

by Stephen P. Maran

The Crab nebula, a striking formation of rapidly expanding, glowing gas in the constellation Taurus, may be the most thoroughly investigated object of modern astrophysical science. Technical and popular books on astronomy and every college text on the subject describe the results of these investigations. Current studies are revealing new information about the origins of the nebula.



Hale Observatories

The Crab is a supernova remnant; that is, it consists of matter ejected from the explosion of a massive star. Some supernova explosions totally destroy their progenitor stars, while others, such as that which produced the Crab, leave a condensed fragment at the center of the expanding debris. Called neutron stars, these objects are half-again as massive as our sun but no more than a few tens of miles in diameter. The neutron star in the Crab nebula is readily detectable with modern technology despite its small diameter and great distance (about 6,000 light-years from the earth) because it is a pulsar, a source of short, rapidly repeating pulses of radio waves, X-rays, and visible light.

Most astronomers believe the Crab nebula is the remnant of a supernova that was seen and described by Chinese and Japanese astronomers in the year A.D. 1054. Every few years, however, someone challenges this interpretation, and more such challenges have appeared recently.

The Oriental astronomers of 1054 recorded what they called a "guest star," meaning a celestial newcomer in an otherwise familiar constellation. The brilliant "star" was actually the light from an exploding supernova. Further, the explosion almost certainly did not occur in a previously known star. Owing to their great distance from the earth and the dimming effect of dust in interstellar space, most stars at the location of the Crab nebula would be invisible without a telescope. (The telescope, of course, was not invented until the seventeenth century.) Thus, the nature of the star that exploded can only be inferred

OUR COUNTRY WILL CAPTIVATE YOU

OUR SEASHORES WILL SEDUCE YOU

OUR CITIES WILL INTRIGUE YOU

COME LIVE WITH US AWHILE

See why we're a vacation well spent. We'd like to send you our "Everything About Portugal" and "TAP Air Portugal's Value Vacation" travel planning kits. They're yours, for your pleasure, with our pleasure.

Name ______

Address ______

City ______ State ______ Zip ______

Portuguese National Tourist Office, 548 Fifth Avenue, NY, NY 10036. Offices also in Chicago & Los Angeles.

PORTUGAL TAP AIR PORTUGAL

NH 10/82

Kăcĥ-ĕl-ōfen.

Kachelofen. Fashioned by skilled artisans of masonry and ceramic tile, these stately, magnificent central heaters have warmed Alpine homes for 700 years. Housed in museums and castles throughout Europe, they are viewed as national treasures.

The WESO Ceramic Tile Stove from Germany is a direct descendant of Europe's mighty kachelofens. The WESO's cast-iron firechamber is surrounded by thick, hand-glazed ceramic tile which captures and releases the fire's warmth far better than metal could.

The WESO burns wood or coal and offers every efficiency feature you could ask for. Its beauty is breathtaking. Choose from 7 decorator tile colors, and enjoy the WESO's visible fire and all-over warmth. **We have stoves for immediate delivery.**

At last. An efficient woodstove beautiful enough for your home.

Rush me your literature portfolio by first class mail, featuring the WESO in all seven tile colors, complete performance data, details on WESO's new coal stove, and current shipping schedule. Enclosed is $1 to help cover mailing costs.

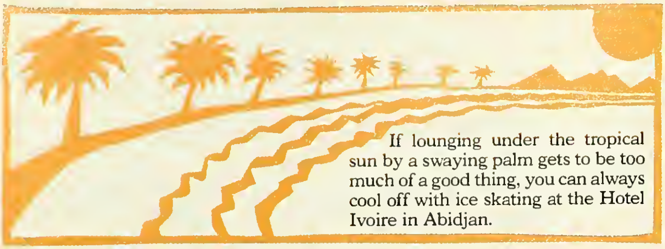
Name ______

Address ______

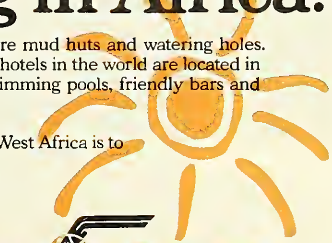
______ Zip ______

Ceramic Radiant Heat
603/524-9663
292A Pleasant Drive
Lochmere, N.H. 03252

The longest, purest beach on the face of the globe isn't Fire Island, Malibu or a Caribbean island. It's the Atlantic coast of Mauritania. Four hundred and fifty miles of uninterrupted sea, sand and sky.


If lounging under the tropical sun by a swaying palm gets to be too much of a good thing, you can always cool off with ice skating at the Hotel Ivoire in Abidjan.

Ice skating in Africa?


Say Africa and some people picture mud huts and watering holes. Well, be assured that some of the finest hotels in the world are located in West Africa. Air-conditioned rooms, swimming pools, friendly bars and fine restaurants.

The best way to get to and around West Africa is to fly Air Afrique's luxurious jet service.

Isn't it time you discovered West Africa? Just call your Travel Agent or your nearest Air Afrique/ Air France office today.

AIR AFRIQUE

Africa begins with Air Afrique.
And it's just seven hours to the New Sun... West Africa.

Wildlife Tours

Wildlife safaris Tanzania, Kenya, Botswana

Gorilla viewing Rwanda

Andes, Amazon and Galapagos islands

many other trips

Travel with the experts

Adventures International
4421-N Albert St., Oakland, CA
(415) 531-6564

"DENTIST" BANK

Authentic Cast Iron Replica

Made in U.S.A. from Original 1880 Molds

Place fee (coin) in dentist's pocket, then you press lever. Dentist pulls the tooth, both he and patient go sprawling, while coin falls into base of bank.

10 inches long overall. Order by No. 570, $58.50 each plus $2. shipping cost. U.S. made, perfect replica of 1880 original. FREE 8-page color catalog shows other banks, cast iron toys. Tel.716/396-2656.

ELIZABETH EDGE STUDIOS
Dept. N-102 Canandaigua, N.Y.14424

"Handsome . . . a glint of mischief in his eye . . . the kind of fellow you'd like to have around . . ." This fine quality gentleman fox comes along with his equally elegant lady to grace your own den, living room, tack room or wherever you will appreciate this frisky pair.

Each is six inches high and crafted of corse grained English earthenware, hand-painted and ready to continue their courtship in your home. Just $84.95 the pair.

Mail your check or money order for $84.95 plus $2.50 for shipping and handling to The Morton M. Fox Collection, 293 Keswick Glenside, PA 19038. You may charge on your MasterCard or Visa. Allow 4-6 weeks for delivery.

Join the growing list of fox fanciers by writing for our free catalogue of gifts, collectibles, and other practical and fascinating products dedicated to the Fox.

For faster service call toll free:

800-526-7843 Ext. 149

In New Jersey: 800-522-4503 Ext. 149

THE MORTON M.FOX COLLECTION

by studying its remains, which the great majority of astronomers identify as the Crab nebula and its neutron star.

Recent studies of the Crab nebula, including observations made with a NASA satellite, furnish clues to the nature of the original star that exploded. Previously, we knew much about the consequences of the explosion but nothing about what preceded it.

Modern studies of the Crab nebula have revealed that its most common constituent is not hydrogen, as in the sun and most normal stars and nebulae, but rather helium. The Crab's content of various other elements has also been established, with varying degrees of accuracy. For example, it was found that oxygen is slightly less common in the Crab than in the sun. However, the amount of carbon had not been measured until recently. Carbon is the product of well-understood nuclear reactions within a star, so the amount of carbon in the Crab nebula helps us understand the nature of the vanished stellar furnace in the Crab's progenitor. (Theories of the interior workings of stars sometimes rise or fall according to their success in predicting the amount of carbon present.)

Astronomers determine the quantities of the elements in space by observing the spectra of stars and nebulae and measuring the strengths of spectral lines caused by the absorption or emission of light by atoms of the respective elements. Until recently we were ignorant of the amount of carbon in the Crab because, as it happens, there are no spectral lines in the visible light spectra of nebulae that are suitable for measuring carbon abundance. Instead, the appropriate lines are located in the ultraviolet region of the spectrum, which must be observed from space because ultraviolet rays do not penetrate the earth's atmosphere. The problem of measuring carbon in the Crab became susceptible to investigation after January 1978, when NASA launched a satellite observatory for ultraviolet spectroscopy. The satellite, the *International Ultraviolet Explorer*, or IUE for short, was described in "Telescope in Space" (*Natural History*, July 1980).

A few years ago, I organized a team of astronomers from the Goddard Space Flight Center in Maryland and two nearby universities to study carbon in the Crab nebula with the IUE. We soon joined hands with a second team led by Kris Davidson, an authority on the Crab at the University of Minnesota in Minneapolis. It turned out that the Crab was much harder to observe with the IUE than had been anticipated, so the collaboration with Davidson, which included pooling the observing time that each group had been granted, was vital to our success.

The main problem in observing the Crab with the IUE is that the telescopic image of the nebula is much larger than the entrance slit of the spectrograph at the focus of the satellite telescope. This means that we could only focus a small fraction of the Crab's ultraviolet light into the spectrograph. Thus, it was vital to home in on the brightest spot in the nebula. That sounds easy enough, but "brightest" in the preceding sentence really means "brightest in ultraviolet light," and there are no photographs of the nebula taken in that band of wavelengths, nor is there any existing camera that can make such pictures. The procedure we adopted, therefore, was to guess at the most likely locations from telescopic photographs made in other wavelengths of light, which revealed the filaments of the nebula most likely to have the proper conditions for bright ultraviolet emission. Then we made test exposures with the IUE spectrograph. Unfortunately, the nebula is so dim in ultraviolet light that only one exposure can be obtained during an eight-hour shift of precious satellite time. Due to the slow pace of this procedure, we used nearly all the observing time granted to both groups in 1979 just to find the best place in the nebula to make the observations, and obtained only weak evidence concerning the amount of carbon in the Crab.

In 1980, we were granted further observing time to measure carbon in the Crab nebula with the IUE. In the meantime, Ted Gull, a Goddard astronomer known for his work on supernova remnants and nebulae, had been experimenting with computer techniques for adding together poorly exposed ultraviolet spectra. This was necessary because, even when our observations focused on the brightest spot in the Crab, a long time exposure yielded only a very weak spectrum. Further, the spectra were marred by slight defects in the electronic camera of the satellite and by so-called radiation hits. Camera defects don't pose serious problems for most IUE observations because their effects can usually be distinguished from the features of the ultraviolet spectrum. However, we found that the ultraviolet spectral features of the Crab nebula are so weak that it is hard to tell them from the results of a camera defect.

Radiation hits are caused by cosmic rays and atomic particles of the earth's Van Allen belt. These tiny troublemakers penetrate the satellite observatory and strike the camera. With long exposures, as were necessary in the Crab study, the camera naturally suffers more hits per exposure. The hits produce little bright spots, sometimes resembling miniature comets, in the spectra. Again, in some cases, it is hard to tell a real spectral feature from a radiation hit. Gull's computer work led to a computer program that removes the effects of camera defects, and that compares, adds, and averages several spectra at a time, making judgments as to which features are real and which are radiation hits.

We observed the Crab with the IUE satellite on sixteen days in August 1980. The individual spectra obtained on these occasions each looked terrible to the practiced eye of specialists in ultraviolet astronomy. But when the spectra were combined and processed with a computer, the results were much better. The processed spectra revealed that carbon is present in the Crab in an amount about equal to oxygen. We consulted modern theories of stellar evolution and supernova explosions, especially those of Ken'ichi Nomoto, a noted authority on supernovae at the University of Tokyo, to determine the significance of this finding. Considered together with other known properties of the Crab nebula, the information on carbon and oxygen levels allows us to pin down the nature of the presupernova star, or progenitor, with remarkable precision.

The explosion of a very massive star,

Thank Goodness for Flannel Sheets!

I Thought I'd "Freeze to Death"

When I went to England, I just knew it was going to be the trip of a lifetime. I had saved and planned for years. Then, out of the blue, I got a chance to spend a few days in an honest-to-goodness 13th Century castle on the moors in Yorkshire.

What I overlooked was the English idea of central heating. After I left London the weather suddenly turned shivering cold and wet. By the time I got to my destination I was too tired and miserable to care about picturesque charm and history. All I could think of was how uncomfortable I was going to be in an old, drafty castle.

Sure enough, my room was *freezing*. But when I crawled into bed I was dumbfounded to discover how marvelously cozy it was despite the lack of heat.

There was a big, puffy down comforter on top. Underneath, the sheets and even the pillowcases were flannel. And not that flimsy, pilled kind we used to have at summer camp. They were luxuriously soft, thick real *English cotton flannel.*

I felt utterly pampered in plushy comfort. And I never slept better, because I wasn't buried under layers of heavy bedclothes.

Then and there I decided I was going to have sheets like that at home. What a great way to save on heating costs at night and still feel rich and special!

When I got back to the United States I soon learned that the flannel sheets in stores didn't feel or look the same at all. The polyester in them made such a difference.

Finally, I got so frustrated I went to Damart, a company in my home town, and suggested they sell real English flannel sheets and pillowcases. They loved the idea.

And that's how Agatha's Cozy Corner was born. We talked it over and added heavenly down comforters and some other things as well as the sheets. And now I'd be happy to send you my catalog. It's printed in color, and gives you the pictures and story of everything we sell. Just use the coupon for your free copy.

© 1982, Agatha's Cozy Corner

AGATHA'S COZY CORNER
DEPT. NH102
Woodbury Plaza
Portsmouth, N.H. 03801

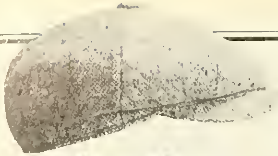
Yes! I would like to receive a FREE copy of Agatha's Cozy Corner Catalog. Please send it right away.

PRINT NAME

Address

City

State Zip



SPORTS CAR CAP

A look that recalls the heyday of the Stutz speedster and white flannel trousers. Wool tweed cap with eye-shading visor is fully lined for comfort. Untuck the pile-lined earflaps for top-down motoring. **Colors:** Tan tweed or Black/Gray tweed. **Sizes:** S(6¾-6⅞), M(7-7⅛), L(7¼-7⅜), XL(7½-7¾). **$14.95** ppd.

Order Today! Money Back Guarantee!

Here is my check or money order for $________
(Add sales tax for delivery in CA, CO, D.C., IL, MI, PA, WA).
RUSH my **#1914 Sports Car Cap.**
Color ________ Size ________
Name ________
Address ________
City ________
State ________ Zip ________

☐ **Send me your FREE color catalog of quality outdoor apparel and equipment.**

Eddie Bauer®

Dept. ENH, Fifth & Union, Seattle, WA 98124

The Wilderness Travel
World of Discovery

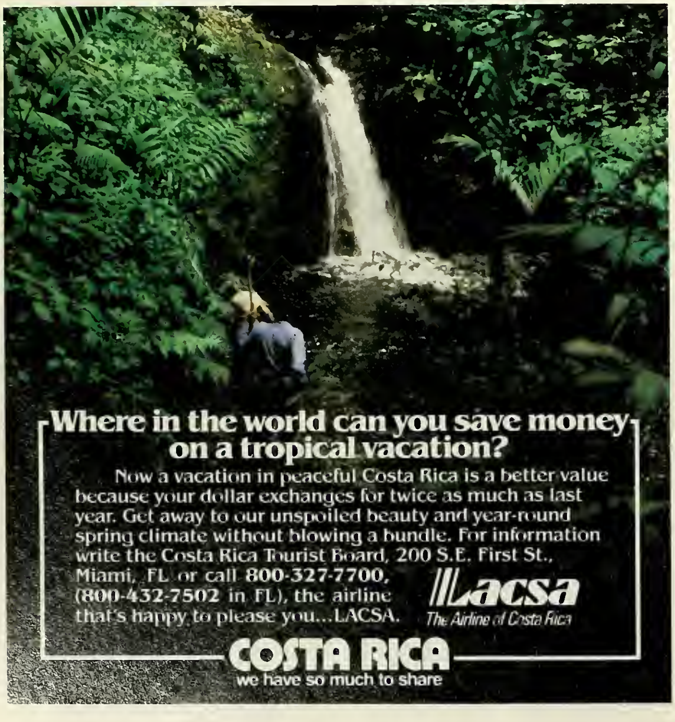
Wildlife & Natural History Tours
Anthropology & Archaeology Tours
Trekking Expeditions
Jungle Exploration

• CHINA •
• Kenya • Tanzania • Galapagos •
• Peru • Ecuador • The Amazon •
• Nepal • Australia •
• Alaska • New Guinea •

Write for our 32-page
fully illustrated catalog

Name ________
Address ________
Zip ________

WILDERNESS TRAVEL
1760-N Solano Avenue, Berkeley, California 94707
(415) 524-5111



Where in the world can you save money on a tropical vacation?

Now a vacation in peaceful Costa Rica is a better value because your dollar exchanges for twice as much as last year. Get away to our unspoiled beauty and year-round spring climate without blowing a bundle. For information write the Costa Rica Tourist Board, 200 S.E. First St., Miami, FL or call 800-327-7700, (800-432-7502 in FL), the airline that's happy to please you...LACSA.

LACSA
The Airline of Costa Rica

COSTA RICA
we have so much to share

one with more than fifteen times the mass of the sun, liberates vast amounts of oxygen that have been created by nuclear reactions within the star. Since the Crab is not unusually rich in oxygen and, in fact, contains less of that element than the sun, its progenitor star must have been lighter than 15 solar masses, a circumstance already suspected. Stars somewhat lighter than 15 solar masses create lots of oxygen, but the oxygen is located deep inside the star, below the level of the material ejected in a supernova explosion. These stars make carbon as well, but the carbon is located in a layer above the oxygen. Stars in the range of about 10 to 15 solar masses expel much carbon and little oxygen when they explode. Since we found that carbon and oxygen are present in comparable amounts in the Crab, the progenitor must have been lighter than about 10 solar masses. In a 9-solar-mass star, the exploded material comes from above the layer where most of the carbon is found and is not especially rich in either carbon or oxygen.

The nature of a supernova explosion apparently depends on the initial mass of the star, rather than on its mass when the explosion occurs. A star with a great initial mass will explode like a heavy star even if it has managed to shed most of its mass (by means, say, of stellar winds) long before the supernova outburst occurs. When a star is initially lighter than about 8 solar masses, the explosion totally disrupts the star, leaving no neutron star. (A smaller star, with an initial mass of perhaps five times that of the sun or less, may not explode at all.)

All of the above can be summarized as follows: the progenitor of the Crab nebula supernova had an initial mass less than ten times that of the sun (since carbon and oxygen are present in comparable amounts in the nebula), but the mass was at least eight times that of the sun (since the star was survived by a neutron star). Thus, we think the progenitor was initially an 8- or 9-solar-mass star. As such, it must have spent most of its life as a blue-white star, a little heavier than Alkaid, the star at the end of the handle in the Big Dipper, but a little lighter than Spica, the bright star in the constellation Virgo.

The finding that the progenitor of the Crab nebula was initially an 8- or 9-solar-mass star means that much of its mass is missing. The nebula itself amounts at most to 3 solar masses. The neutron star weighs in at about 1.5 solar masses. That leaves about 3.5 to 4.5 solar masses to be accounted for. However, observations with the IUE and ground-based telescopes indicate that stars as heavy as the Crab progenitor do have stellar winds strong enough to shed that much mass before they become supernovae. The wind-blown mass, which may have departed the star millions of years ago, has dissipated into space far beyond the confines of the Crab nebula. In December 1981, two British astronomers from the Royal Greenwich Observatory and the Rutherford Appleton Laboratory reported finding a very faint halo of gas that supposedly surrounds the Crab nebula, extending well beyond its recognized boundaries. That halo might consist of the missing mass, but both the discovery of the halo and this explanation of its nature remain to be confirmed.

What about the claim that the Crab nebula is not the result of the supernova explosion of 1054 as seen in China and Japan? The latest such argument was written by L. Pearce Williams, a historian of science at Cornell University. Williams is concerned by some discrepancies between the Oriental "guest star" reports and modern measurements of the Crab nebula. Most of these points have been noticed and discounted before. Williams, however, also reads the Oriental reports in a way that convinces him (unlike most others) that the 1054 supernova was not a spectacular sight. He concludes that, although there was a nova or supernova explosion in 1054, it was not the one that produced the Crab. I don't find his reasoning convincing. Indeed, one is reminded of the literary researcher who supposedly determined that Shakespeare's plays were written "by another man of the same name."

Williams seems to have been unaware, when he drafted his recent article, of the Arab record of the 1054 supernova. The Arab account, which was found a few years ago, seems to confirm that the 1054 supernova *was* a brilliant sight. Nevertheless, students of the Crab may be enormously indebted to Williams. For many years, the real puzzle in the historical accounts of the Crab has been the absence of any report that the supernova was seen in Europe. Yet Williams has apparently found just such a record in the Rampona chronicle, a manuscript he describes as "compiled in Bologna about the year 1476 from an earlier source that is now lost. . . ." On balance, therefore, Williams's objecting article only reinforces my strong belief that the brilliant stellar explosion of 1054 gave rise to the astrophysical spectacle we now call the Crab nebula.

Stephen P. Maran is a senior staff scientist in the Laboratory for Astronomy and Solar Physics at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

Tall & Big Men

Send for this FREE catalog

Finally, you can get a good selection of great-looking clothes that fit!

Instead of getting sold short in stores that carry only a limited selection in your size, send for 96 pages of smart-looking clothes guaranteed to fit!

What a guarantee!

Your order from The KING-SIZE Co. is GUARANTEED both BEFORE and AFTER Wearing, Washing or Dry Cleaning. Unless you are fully satisfied, you may send it back for a full refund or exchange.

IT'S ALL HERE!

- ★ Brand-name shirts up to 22" neck and 38" sleeve
- ★ Slacks and jeans to 60" waist and 38" inseam
- ★ Jackets and outerwear to size 60
- ★ Shoes, boots, work shoes, and sneakers to size 16EEE

FREE COLOR CATALOG

Please send the latest KING-SIZE Co. full-color Catalog to me at the address below

My Telephone Number ______ ______
Area Code
Name ______
Address ______
City ______ State ______ Zip ______

THE King-Size CO.

7222 King-Size Bldg. Brockton, MA 02402

The original Teddy Bear. Handcrafted in Germany since 1903. Available at fine toy and department stores.

Steiff
BUTTON IN EAR

A lifetime of love.

The World 'n General

GENERAL TOURS
presents
THE PRICELESS VACATION YOU CAN AFFORD

RUSSIA
FALL/WINTER/SPRING

from $899*
including air fare

8-14 days

- East/West Coast departures.
- Finnair wide-body jets
- first class & deluxe hotels
- three meals a day
- full sightseeing
- all transportation in USSR
- theater performances
- American tour manager

*Per person double occupancy from NY

ASTA USTOA
Member First Family of Travel

What A Way To Go!

GENERAL TOURS, INC.
711 THIRD AVE.
NY, NY 10017
212-687-7400
NHR 10/82

Please send my free copies of:
☐ Russia ☐ China ☐ Egypt ☐ Scandinavia
☐ Kenya ☐ Holyland

name ____________
address ____________
____________ zip ______
my travel agent ____________

Biorhythm Bunkum

Biorhythm vendors promise to chart your future ups and downs. Don't count on it

by John D. Palmer

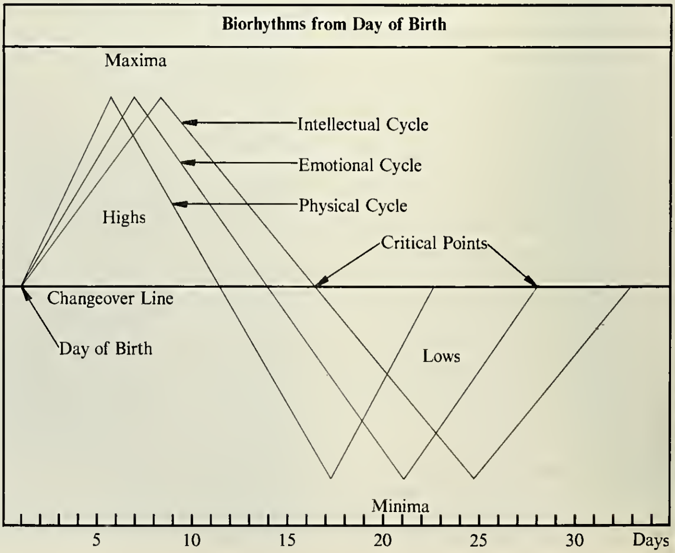
Every generation has produced its share of soothsayers and fortunetellers who, often with the aid of a mysterious crutch such as a crystal ball or slurry of chicken offal, eke out a living from the gullible. Today, stock-market analysts have largely supplanted crystal-ball gazers, and biorhythm charts rather than animal entrails are the tools of the modern haruspex.

The so-called science of biorhythm analysis, which provides custom charting of the vicissitudes of every individual's life, is now a multimillion-dollar business. Since no occult skills or human sacrifices are required—only an ability to count and divide—biorhythm charting has caught on and is widely practiced in America and abroad. For the uninitiated, a short course is in order.

According to the biorhythm hypothesis, our bodies and minds are constantly experiencing three cyclic patterns. Our physical characteristics, such as overall strength and mechanical abilities, are stated to undergo a 23-day cycle. Our emotional state changes on a 28-day schedule, while our intellectual skills follow a 33-day oscillation. All three cycles start at the instant of one's birth, and then follow exact, wavelike patterns for the rest of one's life. Being of different lengths, the cycles are in a constantly changing relationship with one another.

Each of the three cycles is divided into high and low phases. The high days of the physical cycle are characterized as times of strength, endurance, and boundless energy. During the low days, characterized by relative fatigue and listlessness, the body's muscles are supposed to be recharging for the next high phase. This would not be a time to enter a marathon race.

During the fourteen high days of the emotional cycle, people tend to be cheerful, optimistic, and loving. The low fortnight that follows is a time when spirits ebb; we tend to be irritable, pessimistic, and on edge. In the intellectual cycle, a



16.5-day phase of mental alacrity and marvelous problem-solving capability alternates with an equally long period of dullness.

In all three cycles, the highest points, the *maxima*, signify the pinnacles of performance, while the lowest points, or *minima*, are the nadirs of ability and emotional well-being. Each of the cycles has two other points of intense importance as well: the days when they cross the change-over line from either high to low or low to high. These "critical days" are defined as potentially dangerous times, when people are prone to poor judgment, foolish acts, and accidents. Because we all must endure an average of one critical day every four to five days, it is little wonder that we live lives of quiet desperation.

About once every eight weeks, two of the three cycles reach critical points on the same day. Much more rarely, critical days in all three cycles will occur simultaneously. The risk of foolish, dangerous behavior and poor health is greatly augmented on these "double" and "triple" days. Even more rarely, the cycles align so that the highest or the lowest points of two or even all three cycles occur simultaneously. Double and triple highs represent the most joyous times to be alive; double and triple lows are especially dismal.

Several million people apparently believe in biorhythms. Both feeding on and encouraging their faith are any number of entrepreneurs selling books and newsletters, calculators for instantly determining one's daily phases, and computer printouts of one's cycles for the coming year. For the well-heeled believer, a $3,000 decorative desktop computer for making biorhythm calculations is offered. All these gadgets are convenient but unnecessary: people can plot their present position in a cycle simply by dividing their age in days by 23, 28, or 33. The fractional remainders of these computations tell how many days into each cycle a person is.

Biorhythm salesmen promise great financial rewards, a better love life, and freedom from accidents. One full-page

BIG BRASS
THE PAPERWEIGHT PEN

Nearly ¼-lb of solid brass ... yet it glides across the page with the effortless grace of an 18th Century Goose Quill Pen.

- Limited Collectors Edition of only 9,999 pieces.
- Each pen in this Limited Edition is accompanied by an individually numbered and registered Owners Certificate.*
- The name of the owner is hand-inscribed in brass to a depth of 100 microns.
- Accepts standard replacement refills.

Your name or friend's name hand-etched on the face.

The grace of an 18th Century Goose Quill

The heft of solid brass

SERIES A COLLECTORS EDITION

PRICE $25.

LIMITED TO ONLY 9,999 PIECES

GIFT BOXED

50-YEAR GUARANTEE

Each Pen includes a 50-Year Guarantee covering every working part, including its solid brass casing, machined threads, and interior mechanism.

*LOW NUMBERS: Many collectors desire low numbers. Therefore please act promptly. All orders are filled as received.

(D70380)

MAIL TO: Delucca, Goldrich & Lord, Ltd., BIG BRASS PEN OFFER,
Dept. 569-19, Box 1020, Westbury, New York 11595

GENTLEMEN: Please send me:

☐ One BIG BRASS PAPERWEIGHT PEN at the limited edition price of only $25 plus $2 shipping and handling.

☐ **20% SAVING:** Two PENS for only $39.95 plus $3 shpg. & hdlg.

☐ **Payment of $_____ enclosed.** (In NY add sales tax.)

Or charge to my ☐ **VISA** ☐ **MASTER CARD**

Card # __________

Exp. Date __________

(Allow approximately 4 weeks for engraving and delivery.)

Name __________

Address __________

City __________

State _____ Zip _____

PLEASE PRINT NAME TO BE ENGRAVED:

(23 letters maximum)

PHONE TOLL-FREE

DIAL: 1-800-645-3197, Ext. 186.
(N.Y. State: 516-997-8881, Ext. 186.)
VISA OR MASTER CARD REQUIRED.

© 1982 Delucca Goldrich & Lord Ltd

LOWEST COST **PANAMA CANAL CRUISE**

Before You Select ANY Trans-Canal Cruise . . . Review our colorful Brochure! 4 to 9 Nights, from $649

Our unique cruise visits areas never before possible without our **Explorer Class**™ vessel.

You'll discover the exciting archaeology and cultures that brought the world-famous explorers — Balboa, Sir Francis Drake and the colorful pirates — to Panama. See **Colonial Panama**, historic attractions, colorful **Indian tribes** plus beautiful scenery, beaches and marine life . . . all from the comfort and convenience of our new **Explorer Class**™ cruise ship, featuring 44 air conditioned **staterooms**, each with private facilities. Plus, there's a picture-windowed **dining room** serving delicious meals, a **lounge** with bar, and spacious **sundecks** offering an extraordinary view.

Varied ship and shore programs allow explorers of all ages to fully enjoy this extraordinary experience.

After the cruise, extend your stay with optional interludes at world-famous Contadora Resort and Casino, or at the brand-new Bambito Resort Hotel.

If you're considering any **Panama Canal Cruise**, send for our brochure first . . . we'll really show you Panama — in addition to the canal transit.

For best selection of stateroom and cruise date, **plan now; to obtain a free full-color brochure, see your travel agent, mail coupon below or call toll-free: 800-426-0600**

(in Washington State call: 206/624-8551).

ASK ABOUT SPECIAL AIR FARES!

EXPLORATION CRUISE LINES™
1500 Metropolitan Park Bldg., Dept. AIF, Seattle, WA 98101

Please send me a free copy of your new Panama Cruise Brochure.

NAME

ADDRESS

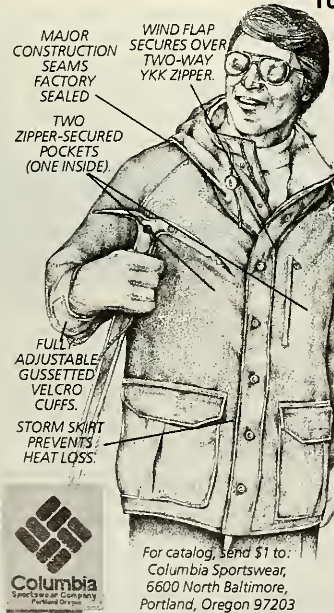
CITY STATE ZIP

Item: The Trinity Alps

DESCRIPTION: Gore-Tex™ Thinsulate® Foul-Weather Parka.

SPECS:

Fabric: Gore-Tex™ laminated to Exacta™ Cloth.
Inside: Gore-Tex™ lets perspiration escape, but completely blocks rain, mist, etc.
Outside: Durable, snag-proof Exacta™ Cloth for long wear.
Insulation: Thinsulate® (200 gms./sq. meter). Extends to full length and hood. Factory-sealed major construction seams eliminate leakage.
Lining: Nylon taffeta.
Pockets: Total—6, 2 zipper-secured upper pockets, 2 Velcro-secured lower cargo pockets with "bellows" pleats for extra capacity, and 2 hidden Thinsulate® lined hand-warming pockets.
Hood: Permanent full cut for wear over headgear or alone. Drawstring provides weather seal. Soft visor shields glasses/goggles from rain.
Gen. Notes: Men's S to XXL. Women's XS to L. Made in Portland, Oregon.


MAJOR CONSTRUCTION SEAMS FACTORY SEALED
WIND FLAP SECURES OVER TWO-WAY YKK ZIPPER.
TWO ZIPPER-SECURED POCKETS (ONE INSIDE).
FULLY ADJUSTABLE GUSSETTED VELCRO CUFFS.
STORM SKIRT PREVENTS HEAT LOSS.

For catalog, send $1 to:
Columbia Sportswear,
6600 North Baltimore,
Portland, Oregon 97203

Columbia Sportswear Company Portland Oregon

Thinsulate ZEPEL GORE-TEX

We don't just design it. We engineer it.

Thinsulate® is a registered trademark of 3M. Gore-Tex™ is a trademark of W. L. Gore & Assoc., Inc. ZEPEL® is a registered trademark of Du Pont.

Arnold Palmer after winning the 1972 British Open golf tournament

UPI Radiotelaphoto

newspaper ad states that Mrs. Audrey Sturm, using one company's biorhythm charts, waited for a triple-high to play Keno in Las Vegas. When the magic day arrived she bought a dollar ticket and won $18,000. Another ad shows a beaming Jackie Bouvier, who is reported to have met John Kennedy on a double-high day, thus starting her ascent to fame and greater wealth.

As "proof" of the impact of biorhythm phases, book authors and other proponents offer examples where good and bad events involving celebrities correspond to their cyclical phases. An oft-cited example comes from the sporting world. In July of 1962, Arnold Palmer easily and gracefully won the British Open golf tournament. The press described him as being "unusually" affable that day. As the adjoining chart shows, his biorhythms registered a near triple-high on that winning day. Just two weeks later Arnie took a surprising seventeenth place in the PGA Championship, and his sociability on that day reportedly ranged more toward the nasty end of the spectrum. All three of his cycles had traveled to their low phases. In the same vein, Jim Marshall of the Minnesota Vikings made his infamous wrong-way run for a touchdown on a triple-low day.

We are told that terrible things often happen to notables on their critical days. Presidents Coolidge, Eisenhower, Hoover, and Truman all died on one of their critical days. John Kennedy's intellectual cycle was at a critical point on that fatal day in Texas when he decided to leave the bulletproof bubble off his limousine. His brother Edward made a blundering wrong turn on Chappaquiddick on a double-critical day. General Custer stood his last stand on a critical day in his physical cycle. Janis Joplin and Marilyn Monroe took fatal drug overdoses on double-critical days. And when John Hinkley tried to kill Ronald Reagan, only a ricocheting bullet of one of the six shots he fired struck the President. Hinkley was about to enter a physical-critical point that day.

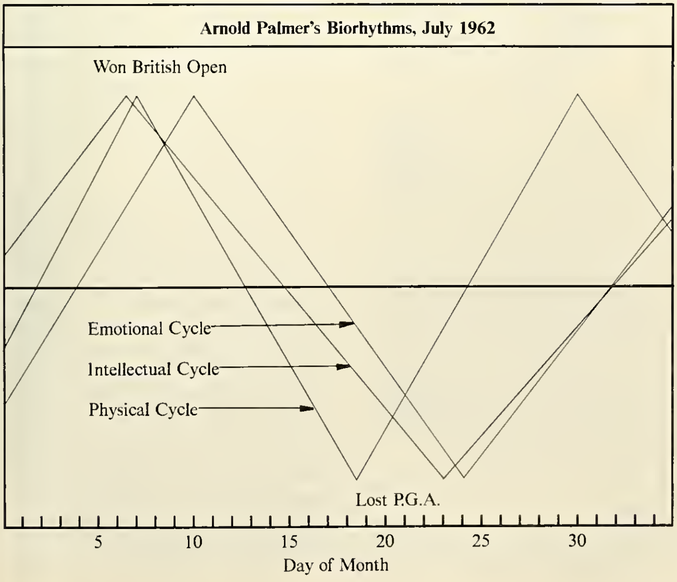
Proponents of biorhythm theory also cite examples of industrial accident prevention. The Ohmi Railway Company in Japan determined the biorhythms for all its employees and notified each in advance of impending critical days. The warnings are reported to have produced a 50 percent reduction in the company's accident rate. Similar reports come from other companies.

Some thirty books provide many additional examples that seem to bear out the biorhythm hypothesis. However, I must report that, as a physiologist studying the cyclic aspects of plants, animals, and humans—what scientists call biological rhythms—I find the biorhythm hypothesis more than a little suspect. In particular, it is inconsistent with scientifically documented knowledge of all other cycles in living creatures. For example, the assertion that the cycles are exactly 23, 28, and 33 days long in everyone runs contrary to what genetics teaches us. Variability among individuals is the rule. Consider the menstrual cycle: It averages 29.5 days in length but varies from about 10 to as much as 55 days among individual women.

A second problem is the claim that none of the three cycles ever varies an iota from its ordained length. By contrast, while we think of our heartbeat rhythm as being regular, it is actually in constant change, modified by physical exertion and emotional state. Even an individual woman's menstrual cycle only averages a certain length; some "months" it is longer and some shorter depending on a host of modifying influences.

Third, there is no logical reason for all three biorhythms to start together on the day of birth. Why not when egg and sperm fuse or at the moment the embryo implants in the uterus? Other known biological cycles often do not start at birth. The daily metabolic rhythm of the chick begins fourteen days before it hatches; the human daily rhythm of sleeping and wakefulness does not begin until many weeks after birth. Also, if biorhythms did start in unison as a child exits from the birth canal, the consequences should be dire. By definition, this would be a triple-critical day! And within the next seventeen days the newborn would experience three more critical days, for a total of six critical points in just over two weeks. Not a good augury for infant survival.

Finally, the notion of a critical point makes no scientific sense. Known biological cycles show smooth, uninterrupted transitions from high to low points and


Arnold Palmer's Biorhythms, July 1962

What your home could have in common with the Met, the Tate, and the Louvre.

Wilbur Streech's *The Red Maple*, original serigraph. Signed limited edition of 250.

Beautiful, original works by artists who are represented in the world's great museums and galleries can be yours for very reasonable prices.

We offer original etchings, lithographs and serigraphs signed by Calder, Chagall, Dali, Miró, Renoir, Vasarely and other important artists.

Wilbur Streech's delicate serigraph, *The Red Maple*, is one of the many fine prints we've made available.

Our expert advice and full money-back guarantee are your assurances that the art you buy will have lasting value and beauty.

Send for our colorful, descriptive catalogue, without obligation.

Visit our new gallery located at 215 Lexington Avenue, Mon–Fri, 9–5 PM. Telephone: 212-685-9400 Ext: 35

© 1982 OPCG, LTD

Original print collectors group, Ltd.

215 LEXINGTON AVE.,
DEPT. NH-46, NEW YORK 10016

PLEASE SEND ME YOUR FREE COLOR CATALOGUE WITHOUT OBLIGATION.

NAME ____________ PLEASE PRINT
ADDRESS ____________
CITY ____________
STATE ________ ZIP ________

back. For example, our body temperatures are lowest each day in the early morning hours and highest at about 8:00 P.M. (98.6° F is just a daily average). Halfway through the day we don't momentarily risk boiling to death, and halfway down from the 8:00 P.M. high we don't briefly risk freezing solid. In all known biological cycles, the halfway points between highs and lows are simply uneventful intermediates—nothing more, nothing less.

Most historians credit Wilhelm Fliess, a German nose and throat specialist, with the discovery of two of the three biorhythms. Fliess's odd theories were not confined to biorhythms. After probing many nasal cavities, he became convinced that he could identify genital cells therein, and in 1897 he published this unusual idea in a best seller entitled *The Relationship Between the Nose and the Female Sex Organs from a Biological Aspect*. He treated a wide variety of physical and mental illnesses by applying cocaine to these nasal cells, and since his treatment was a treat, he soon had one of the largest medical practices in Berlin. Among his willing patients was Sigmund Freud, a long-time experimenter with cocaine. Freud had at least two "nose jobs" under Fliess's skillful hands.

Along with nostrils and narcotics, Dr. Fliess was obsessed with numerology and was particularly intrigued by the numbers 23 and 28. His observations of humanity convinced him that we are all bisexual, and that each of us possesses a 23-day male and a 28-day female cycle. These cycles have since been renamed the physical and emotional biorhythms. He shared his "discovery" with Freud, who became a true believer in the most fanatical sense, to the point of believing that he would die at age fifty-one (23 + 28). He didn't, although Fliess did die in 19*28*. The two became close friends.

With Freud's blessing, in 1906 Fliess put his thoughts on biorhythms into a book called *The Course of Life: Foundations of an Exact Biology*. The book was not well received; in fact, one reviewer went so far as to describe it as a "masterpiece of Teutonic crackpottery." Fliess presented his conclusions but omitted the data on which they were based. The latter have since been reportedly destroyed in the Second World War. Thus, we have no supporting documentation for such tidbits as the conclusion that children conceived during their parents' emotional highs (meaning peaks in their emotional biorhythms, not those resulting from cocaine sniffing) are left-handed.

Viennese psychologist Herman Swo-

I'm right here in America– and I need you for a friend.

Annie is typical of many American Indian children who may not stay in school without the help you can give.

She's bright as a button. But her father can't find permanent work and her mother must care for brothers and sisters who live with her on an Arizona reservation.

Her family and tribe are proud of Annie's progress in school and they want her to finish. And now, happily, she has a Futures sponsor someone like yourself who will help make it happen.

But there are many other Annies: school-age girls and boys on reservations who need your help.

Through Futures for Children you can sponsor one or more of them. Your contribution of $25 a month will buy new jeans, shoes, a warm coat for cold winters, personal items, school supplies, and much more. *And you'll enrich your own life in coming to understand a different culture—right here in the United States.*

So you don't have to look far to find a child who needs your help. You'll receive a picture of your Indian child, a personal history, and lots of information about life in Indian America. What a thrill to get that first letter from your Indian child! Write your check to Futures today. Please send it with the coupon below.

_____ I want to sponsor an American Indian child ☐ boy ☐ girl ☐ either NH 1082
_____ Enclosed is a check for $__________
($25 monthly, $75 quarterly, $150 semi-annually $300 annually)
_____ Can't be a sponsor now but I'd like to help your program. Enclosed is my tax-deductible donation of $__________
_____ Send me more information about sponsoring an American Indian child
Let me help your community program for Indian parents. Here is my contribution of $__________ and please send me more information
Name __________
Address __________
City __________ State ______ Zip ______

Futures For Children (All contributions are tax-deductible.)
4401 Montgomery Blvd. N.E. #194 Albuquerque, NM 87109 Toll Free (800) 545-6843 In New Mexico (505) 881-6616

Treasures From The Earth

Color Portfolio of Natural Specimens and Catalog of Minerals, Display Stands, Books and Natural Jewelry, $3.00

Dover Scientific
Box 8011C Long Island City, NY 11106

For the sixth year, we invite adventurous travelers to join us on a unique travel experience

The Snows of Kilimanjaro

FEBRUARY 4 TO 21, 1983

Our expedition begins with a wildlife safari to Ngorongoro Crater, the Serengeti Plains and Lake Manyara, where we also undertake hikes to prepare us for the ascent of Africa's highest mountain, crowned with its permanent icecap

In order to make the climb not only memorable but enjoyable, we allow plenty of time for resting at huts and camps to become used to the high altitutde

Detailed brochure of the expedition and a copy of our newsletter which lists all our fascinating travel programs, available from:

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

LEARN
BIRD BIOLOGY
AT HOME

Cornell University's Laboratory of Ornithology offers a Home Study Course in Bird Biology

Enrich your understanding of the world around you with this home study course in ornithology. One of the world's leading centers for the study of birdlife offers you nine lessons written by prominent American ornithologists and lavishly illustrated by well-known bird artists and photographers. For information on how you can enroll, please fill in the coupon and send it to:

Seminars in Ornithology
Dept NH, Laboratory of Ornithology
159 Sapsucker Woods Road
Ithaca, New York 14850

YES. Please send me information on the Bird Biology Course.

Name __________
Address __________
City ______ State ______ Zip ______

boda is sometimes considered a codiscoverer of biorhythms. This dubious honor is probably misdirected; Swoboda was not yet fifteen years old when Fliess and Freud were corresponding with each other about the biorhythm hypothesis. Nevertheless, just after the turn of the century, when Swoboda was thirty-one years old, he published a book on the subject claiming himself as discoverer. Fliess, a powder keg of a man, angrily denounced Swoboda's claim. Fliess charged that Swoboda, as a young patient of Freud's, had learned about biorhythms from his healer. In any case, Swoboda does deserve credit for conjuring up the concept of the "critical day." His magnum opus on biorhythms, *The Year of Seven*, was supposedly based on "trunkloads" of data. Unfortunately for the scientific world, all eight of the trunks were apparently destroyed during the Russian occupation of Vienna in the Second World War.

The third and final major composer of the biorhythm symphony was Alfred Teltscher, an Austrian teacher, whose reported olive-drab temperament sets him apart from the other two. While teaching courses in engineering at Innsbruck he noted what all teachers find—that students do better at some times than at others. He elaborated this observation into a hypothesis describing the 33-day intellectual biorhythm. Just how he arrived at this conclusion is unknown, and amazingly enough, the data from which it was derived were also apparently destroyed in World War II.

For years modern scientists were reluctant to investigate the validity of the biorhythm claims, feeling that any such efforts would be at best a waste of time and would certainly bring ridicule from their colleagues. But in the absence of any tempering influences, biorhythm apostles and followers seemed to increase in epidemic proportions. Even the Dallas Cowboys began to consult their biorhythms before each game. Thus scientists had no choice but to investigate biorhythms.

One of the first scientists to take this step was James Fix, a psychologist and baseball fan. Following the old adage of fighting fire with fire, he analyzed the hitting performances of the best batters in the major leagues during the 1975 baseball season. Instead of using the statistics of just a few individuals, he used the first three or four men in the batting orders of all the major-league teams. Fix calculated the biorhythms for each of these players, and to increase the chance of finding large differences, studied the hitting success of players only on days of triple highs, triple lows, and triple-critical points.

600,000

acres of Ceylon tea gardens?
Yes Siree!

...and 1000 miles of sun-drenched beaches, 400 varieties of exotic birds and butterflies, 2500-year-old cities, medieval frescoes, modern hotels...and mountains carpeted with tea. In short, the best of Asia in one, friendly, English-speaking island country. With 25,300 square miles of unusual, unspoiled, undiscovered beauty, we may be the last paradise on earth.

Sri Lanka, once known as Ceylon, is just one hour from India, three hours from Katmandu, Bangkok, Singapore. So you're not just going away. You're going all the way. Tours range from a few days to weeks. All with great value.

We're the perfect place for the adventurous and the curious. For a special vacation. Or an unconventional convention. Write for color folder, tour digest, airfares.

Yes

sri Lanka
Pearl of the Indian Ocean

Name________
Address________
City/State/Zip________
Ceylon (Sri Lanka) Tourist Board/Dept. NH 20 609 Fifth Avenue, New York, NY 10017

CRUISE TO THE WORLD'S HIDDEN CORNERS.

Visit penguin rookeries in Antarctica and isolated tribal villages in New Guinea. See the monuments of Burma and Sri Lanka and the ritual dances of Indonesia. Study the profusion of birds in the Seychelles and the exotic marine life of the Great Barrier Reef.

Learn from our accompanying lecturers and expert guides.

Our 120-passenger World Discoverer is unique, with a combination of expedition capabilities, special landing-craft, and traditional cruise amenities.

Society Expeditions
CRUISES
Dept NH8210W 723 Broadway East, Seattle, WA 98102
I want to know more about Society Expeditions cruising programs. Please send me your 48-page catalog

Name________
Street________
City/State/Zip________
M.S. World Discoverer Registered in Singapore.

Enjoy the romance...
Send for a luxurious color catalogue of beautiful lingerie. French bra and bikini sets, lacy teddies, gowns, kimonos & much more.

Victoria's Secret
designer lingerie

Send $3 to Victoria's Secret, Dept. NH-10
Box 31442, San Francisco, CA 94131
Boutiques in San Francisco, Palo Alto & Cupertino, CA

SOUTH AFRICA

A world in one country.
Expect the unexpected. Abundant varieties of fauna, flora and peoples.
A rich land, unspoiled and beautiful.
For an unforgettable vacation experience, consult your travel agent or ask for your free color brochure, 'South Africa – Gateway to a Continent'.

South African Tourist Corporation,
610 Fifth Avenue,
New York,
N.Y. 10020. NH-1082
Tel. (212) 245-3720.
Telex 649535.
Name____________
Address____________

Where summer is four seasons long.

satour

These triple days occur only rarely, and some players experienced none during the season; thus, a total of only 70 players were found to have experienced one or more of these points in the 1975 baseball season. The findings were that batters performed worst on days when, according to biorhythm dogma, they should have done best, and they had the highest batting averages on triple-critical days.

In a later study conducted in the nickel- and copper-mining area of Sudbury, Ontario, the times of miners' accidents were analyzed to see if significantly more occurred on critical days. Three researchers from Laurentian University studied four hundred accidents (each serious enough to require medical aid) that occurred over nine months. They found that 22.7 percent of the accidents happened on individuals' critical days. But critical days occur, on average, every 4.5 days of an individual's life, or 22 percent of his or her days. Thus, 22 percent of all accidents would be expected to occur on critical days just by chance. That 22.7 percent of mine accidents occurred on miners' critical days is just about what chance would produce. Even more damning, further examination of the same data revealed a virtual fifty–fifty split in accident numbers between the high and low phases of the three biorhythms among individuals.

From the Wyoming State Hospital comes another study that fails to support the biorhythm claim. At the end of each day, patients were asked to rank how they had felt that day on a scale ranging from zero (very bad) to ten (excellent). After they retired at night, a nurse looked in on each of them at half-hour intervals and noted whether they were sleeping peacefully, were tossing and turning, or could not fall asleep. Additionally, nine of the patients who worked in the hospital laundry had their work performances evaluated on a scale of zero (completely inadequate) to ten (excellent) by the laundry-room supervisor. Only after two months of data had been collected were the biorhythms of each subject calculated. The data were then examined to see if the subjects' self-evaluations, sleep patterns, and work efficiency differed on critical and noncritical days. No significant differences were found in any category. Some patients experienced double-critical days during the study, and these produced no real differences either.

Many other studies of this type have achieved the same negative results. One analyzed 8,625 civilian and military aircraft accidents involving pilot error; another analyzed 205 serious traffic accidents in which the driver was known to be

TRINIDAD RAIN FOREST

The **ASA WRIGHT NATURE CENTRE** offers the most convenient introduction to this rich tropical world of nature. Located on the northern mountain range, the Nature Centre provides a comfortable and attractive retreat.

- Rustic plantation setting
- Guides available
- Field trips
- Excellent photographic opportunities
- Five summer seminars

Write or call: **WONDER BIRD TOURS**, Dept. A10, 500 Fifth Avenue, New York, N.Y. 10036. Phone: 212/840-5961.

In 1974 we originated our epoch-making ***Galapagos Islands Thrift Cruises****, which for several years enabled many hundreds of budget-minded travelers who were interested in ecology, wildlife and photography to see these unique islands without luxurious trimmings but under expert guidance.*

Since last year, we offer a budget program including some of the highlights which make a visit to this remarkable archipelago such a renowned tourist attraction. We explore five of the islands in order to view sea lions, iguanas and a large variety of birds, such as the famous Darwin's finches, boobies, frigates and gulls

Galapagos Islands Thrift Program®

MARCH 31 TO APRIL 10, 1983
JUNE 30 TO JULY 10, 1983
AUGUST 11 TO 21, 1983
DECEMBER 31, 1983 TO JANUARY 8, 1984

Our program includes easy hikes on Santa Cruz to see tortoises roaming free and to the top of the dormant volcano at Sullivan Bay, and ample opportunities for swimming and snorkeling. It is ideal for young people and families with children and has been planned during periods of school and college vacations

We do not claim that these programs are as comprehensive as our superb and unrivalled **Discover Galapagos** yacht cruises in January, May and August, 1983, but our meticulously supervised arrangements do provide you with a fascinating introduction to these wonderful islands—and at a third of the cost

Each program is accompanied by one of our expert leaders and a naturalist guide who give informative talks and lead us in the field

Before the week at the islands, we spend two days at the best hotel in Quito, Ecuador's lovely capital in the Andes

Please send for the detailed brochure of these programs — we also specialize in expeditions to Greenland, Mount Kilimanjaro, the Himalayas and the Andes, wildlife safaris to see polar bears in northern Canada and to Scotland, Borneo and Rajasthan, and archeological tours to Peru and Egypt

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

American Museum of Natural History

DISCOVERY TOUR TO THE NILE

Discover the world of ancient and modern Egypt on an American Museum 600 mile Nile Cruise. Explore with three lecturers the rich natural and archeological sites of an area which has fascinated visitors for centuries...A carefully planned itinerary (with a special two-day program in London visiting the British Museum with its curator) provides a relaxing and thorough three-week Discovery Tour. All of the major Nile archeological sites as well as the important wildlife regions are discussed and visited with your balanced team of eminent lecturers. Share with Museum staff and friends an unforgettable cruise. February 6-26, 1983. For further information and itineraries write to the **American Museum of Natural History, Discovery Tours,** Central Park West at 79 St., NY NY 10024, or call (212) 873-1440.

American Museum of Natural History

Discovery Tours

legally culpable. Elaborate statistical techniques were used to compare accident rates on single-, double-, triple-critical, and low days. In every case, in both studies, virtually no more (or fewer) accidents occurred on the supposedly dangerous days than on any other days.

But what about the many cases of accidents or deaths of celebrities occurring on critical days or low points in their supposed biorhythm cycles? Because 22 percent of everyone's days are critical, when an accident occurs the odds are better than one in five that it will be on a critical day. Also, on average, at least one of an individual's three cycles will be at its nadir every nine days. One would not have to search long through accounts of celebrity accidents to find some that happened to occur on a "bad" day. (Even a broken clock signals the correct time twice each day.) Those deaths or mishaps that fit the theory are publicized, and those that don't are ignored. So we read that, after being shot, President McKinley died in the hospital on his next critical day. We don't read that President Reagan was shot, underwent major chest surgery, and didn't die on the next day—which was a physical-critical one for him. We don't read that a close friend of mine suffered a fatal stroke on a triple-high day; she was just an unknown housewife and therefore not newsworthy.

Remaining to be explained is the reported decrease in company accidents when employees are notified in advance about critical days. I believe that the power of suggestion is probably the most important factor at work. Wouldn't you drive with special care if your boss told you, based on a reputedly scientifically sound hypothesis, that your chance of having a car accident the next day was great?

In conclusion, science cannot substantiate any of the claims made by biorhythm advocates. In the absence of evidence, I, like any scientist, can give no credence to the existence of the postulated physical, emotional, and intellectual cycles. In saying this, I realize that my views will probably never change Mrs. Sturms's beliefs, and that on her next triple-high day she will be buying Keno tickets in Las Vegas. I can't blame her; she can lose $18,000 and still break even. The nineteenth-century humorist Josh Billings said it well: "The trouble with most folks isn't so much their ignorance, as knowing so many things that ain't so."

John D. Palmer, professor of physiology at the University of Massachusetts at Amherst, specializes in the study of biological rhythms.

The rare 19th Century Viennese Lantern Style Regulator Clock.

The classic Viennese Lantern Clocks were originally created by the "Grossuhrmachers" of the Black Forest during the 19th Century to individual order.

Now, private collectors only are invited to acquire this exceptional replica, superbly crafted by the Hamilton Clock Company. Solid brass precision movement, with Westminster chimes.

The cabinet is mitered and coped fine wood construction, in your choice of solid mahogany or solid walnut. Dimensions are: 45 inches high, 12 inches wide and 8 inches deep.

This edition will be strictly limited to 1,500.

MAIL THIS COUPON OR CALL 1-800-233-0281 EXT. 175* TO SUBSCRIBE OR FOR FURTHER DETAILS.

***In Pennsylvania call 717-394-7161/Ext. 175**

Please send me more information about the Viennese Lantern Style Regulator Clock. I understand that only 1,500 of these clocks will be made in a Limited Edition.

Name__________

Address__________

City__________

State__________ Zip__________

The Collector's Classic Edition Society, Ltd.

(A wholly owned subsidiary of Hamilton Watch Co. Inc. Dept. 306, 941 Wheatland Ave. Lancaster, PA 17604)

Tahiti, Easter Island, Santiago, Lima.

Our Golden Triangle Tour leaves Los Angeles to Tahiti, Easter Island, Santiago and Lima. With an optional side trip to intriguing Machu-Picchu.
Other flights of fancy include: Project Antarctica; Project Amazon; Archaeological Grand Tour and more.

LanChile AIRLINES
We know South America best.

For more information call your travel agent or call (800) 327-3614. In Florida (800) 432-4081. In Miami (305) 593-2110.

Ms. Bertha Alvarez, Tour Manager
Lan Chile Airlines
7855 N.W. 12th Street
Suite 118
Miami, Florida
Please send a free brochure.

NAME

ADDRESS

CITY/STATE/ZIP

$359.95
f.o.b.
Hartford,
Conn.

Share the Thrills of Exploring Outer Space!

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

Criterion Manufacturing Co.
620 Oakwood Ave., W. Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION, MANUFACTURING CO., Dept. NH119
620 Oakwood Avenue, W. Hartford, Conn. 06110
Please send your free Telescope Guide.

Name

Address

City State

Dynascopes

American Museum of Natural History
Discovery Tours

ARCHEOLOGY TOUR TO MEXICO Jan. 11 to 29, 1983
ANCIENT MAYA ARCHEOLOGY Jan. 31 to Feb. 17, 1983

Discover the ancient civilizations and archeology of pre-Columbian Mexico and the Maya world with the American Museum's C. Bruce Hunter. Sites on the Mexican tour include Mexico City, Cuicuilco, El Tajin, Jalápa, Cholula, Teotihuacan, Tula, Oaxaca, Mitla, Monte Alban, Cuernavaca, Xochicalco and Taxco. The Maya tour includes visits to Merida, Dzibilchaltun, Chichen Itza, Tulum, La Venta, Palenque, Edzna, Uxmal, Sayil, Xlapak and Labna. Tours include colonial towns, museums and the finest accommodations, and are limited to 18 participants. C. Bruce Hunter is Lecturer in Archeology at the American Museum, and author of A Guide to Ancient Mexican Ruins and a Guide to Ancient Maya Ruins. For further information write to DISCOVERY TOURS, American Museum of Natural History, Central Park West at 79 St., NY NY 10024, or call (212) 873-1440.

Additional Readin

Sleep (p. 28)

R.R. Ward's *The Living Clocks* (New York: Alfred A. Knopf, 1971) is a comprehensive account, written for the layman, of the history of biochronometry. Ward explores how biological timing relates to such different phenomena in nature as how leaves sleep, how bees orient themselves, how four particular cells serve as clockworks for the cockroach, and how birds navigate. *Body Time*, by G.G. Luce (New York: Bantam Books, 1973), is another popular and readable account of biological clocks, but because it focuses on research from the early seventies rather than on history, some of the material it covers is out of date. E. Bünning started research in circadian rhythms in 1928 and has been following the botanical, zoological, and medical progress in this field since then. His book *The Physiological Clock* (New York: Springer-Verlag, 1973, revised third edition), a study of circadian rhythms and biological chronometry, is much more technical than the two previously mentioned works but full of important, firsthand information. Physician and mammalian physiologist M.C. Moore-Ede, biologist F.M. Sulzman, and neuroscientist C.A. Fuller wrote the first comprehensive explanation of circadian clocks in mammals: *The Clocks That Time Us* (Cambridge: Harvard University Press, 1982). Chapters investigate the function of mammalian internal clocks (where they are in the brain; how they work; how they control sleep, body temperature, endocrine systems, reproductive cycles, and feeding and drinking behavior), and where they fail and why. Also discussed are diseases of the system, such as certain forms of manic-depressive illness and insomnia. Two scientific articles that form the basis of the present account are: "Human Sleep: Its Duration and Organization Depend on Its Circadian Phase," by C.A. Czeisler et al. (*Science*, vol. 210, pp. 1264–67) and "Rotating Shift Work Schedules that Disrupt Sleep are Improved by Applying Circadian Principles," by C.A. Czeisler, M.C. Moore-Ede, and R.M. Coleman (*Science*, vol. 217, pp. 460–63).

Bountiful Yeoman (p. 38)

According to J. Deetz, the Englishmen who crossed the Atlantic in the seventeenth century and founded Plymouth colony "brought with them a blueprint—in their minds—for re-creating the culture they had left behind." His *In Small Things Forgotten* (New York: Anchor Press, 1972), an account of the archeology of early American life, traces the development of the Anglo-American tradition since the arrival of the colonists at Plymouth in 1620. By examining artifacts left behind by early Americans—the "small things forgotten," among them, ceramics, furniture, and musical instruments—Deetz is able to re-create early American culture and outlook and the changes they underwent. Particularly interesting is Deetz's reenactment of early black American culture, derived from the excavation of a small community in Massachusetts established by freed slaves shortly after the American Revolution. Deetz describes Plimoth Plantation, founded in 1959, in "The Reality of the Pilgrim Fathers" (*Natural History*, November 1969, pp. 32–45). J. Demos's *A Little Commonwealth* (New York: Oxford, 1970) concentrates on family life in seventeenth-century Plymouth. Basing his work on examinations of physical artifacts, wills and inventories, and official colony records, Demos pieces together a general report of the physical setting at Plymouth (housing, furnishings, and clothing) and the structure of the household (husbands and wives, parents and children, masters and servants, wider kin connections). He also speculates on infancy and childhood, coming of age, later years, and the family in a comparative perspective. D. Hartley's *Lost Country Life* (New York: Pantheon Books, 1979), is an account of English rural life when most people were laborers living on, and from, the land. Using as a framework Thomas Tusser's sixteenth-century farming calendar in rhyming verse, Hartley chronicles English country life on a month-by-month basis. She tells how English folk lived from the twelfth through the eighteenth centuries—how they worked, threshed, thatched, rolled fleece, milled corn, brewed mead, kept bees, wove baskets, and carried on all the other tasks and trades of everyday life. *Eating in America*, by W. Root and R. de Rochemont (New York: William Morrow and Co., 1976), is a history of food habits in the United States. Particularly relevant to the article in this issue are chapters on Indian farming and cooking, the first settlers, new foods in the New World, and game. J.C. Drummond and A. Wilbraham trace five centuries of English diet in *The Englishman's Food* (London: Jonathan Cape, 1964). See also "The Ethnogastronomy of Thanksgiving," in which J. Deetz and J. Anderson give a history of the holiday (*Saturday Review of Science*, vol. 55, pp. 29–39).

Giant Conifers (p. 54)

For a more detailed treatment of the Pacific Northwest's massive, long-lived conifers see "Evergreen Coniferous Forests of the Pacific Northwest," by R.H. Waring and J.F. Franklin (*Science*, vol. 204, pp. 1380–86). The best description of the region's forests, climates, and soils is found in *Natural Vegetation of Oregon and Washington* (Portland: USDA Forest Service General Technical Report, PNW-8, 1973). Illustrated with many black-and-white photographs, this book describes in detail the environmental features, composition, and successional patterns in the forest zones, interior valleys, steppes and shrub-steppes, and unusual habitats, such as areas of recent vulcanism, of both states. *Forests: Fresh Perspectives from Ecosystem Analysis*, edited by R.H. Waring (Corvallis: Oregon State University Press, 1979), comprises a series of articles from the Proceedings of the 40th Annual Biology Colloquium. Written for a general scientific audience, it provides a broader view of how forests affect erosion and stream ecology.

Nautilus (p. 64)

J. Cousteau and P. Diolé's *Octopus and Squid*, translated from the French by J.F. Bernard (Garden City: Doubleday and Co. 1973), is primarily about Cousteau's experiences with these animals, but it also contains information about nautiluses, primitive cousins of the octopus that have retained their protective shells. An entire chapter, "In Search Of a Living Fossil," (pp. 223–43), illustrated with photographs, is devoted to the nautilus: its evolution, shell, movements, muscular and nervous systems, eyes, and specialized arms. Far more technical is "Flotation Mechanisms in Modern and Fossil Cephalopods," by E. Denton and J. Gilpin Brown (*Advanced Marine Biology*, vol. 11, pp. 197–268). Turn-of-the-century English zoologist A. Willey, whose work with nautiluses is discussed in this issue's article, summarized his research in *Contributions to the Natural History of the Pearly Nautilus* (Cambridge: Cambridge University Press, 1902).

Rita Campon

Our handy knife-rule fits as neatly in your pocket as it fits your needs.

You've never owned anything like this. Not only is it a stainless steel pocket knife that's just 3" long and 3/16" thick when closed—with two blades of fine Sheffield steel. It's also a 6-inch precision rule engraved by Rabone-Chesterman of England, who are known the world over for precision rules. But, the best part of all? You don't have to go any further than your pocket for it.

Send for the Garrett Wade Knife-Rule and our introductory catalog. It's full of fine woodworking tools.

Garrett Wade Co.,
Dept. 99
161 Ave. of the Americas
New York, N.Y. 10013
Please send me ______ pocket knife-rules(s) @ 29.90 p.p.d.
plus introductory Garrett Wade Catalog.

Card No.______________ Expires.______________
NAME______________
ADDRESS______________
CITY______________
STATE______________ ZIP______________

L.A.'s *Super* Market

Grand Central Market is an exciting example of a vanishing form of food merchandising

by Raymond Sokolov

My bicoastal friend David—in a rush to pick up a quantity of food cheap for a big party—zipped down there once from his perch over the Sunset Strip. And the Grand Central Market on Broadway is certainly a good place for economical shopping. It is Los Angeles's counterpart to the Lexington Market in Baltimore or the Municipal Market in Atlanta—a big indoor market in an old inner-city location, where poor people shop at dozens of competitive retail stalls that specialize in everything from fruit to nuts to meat and even wigs. The Los Angeles Grand Central Market is the most exciting example of this vanishing, old-fashioned form of food merchandising that I know. More than that, as even David on his whirlwind foray out of Filmland could not fail to notice, this shabby-looking food circus reflects the noncinematic realities of poly-

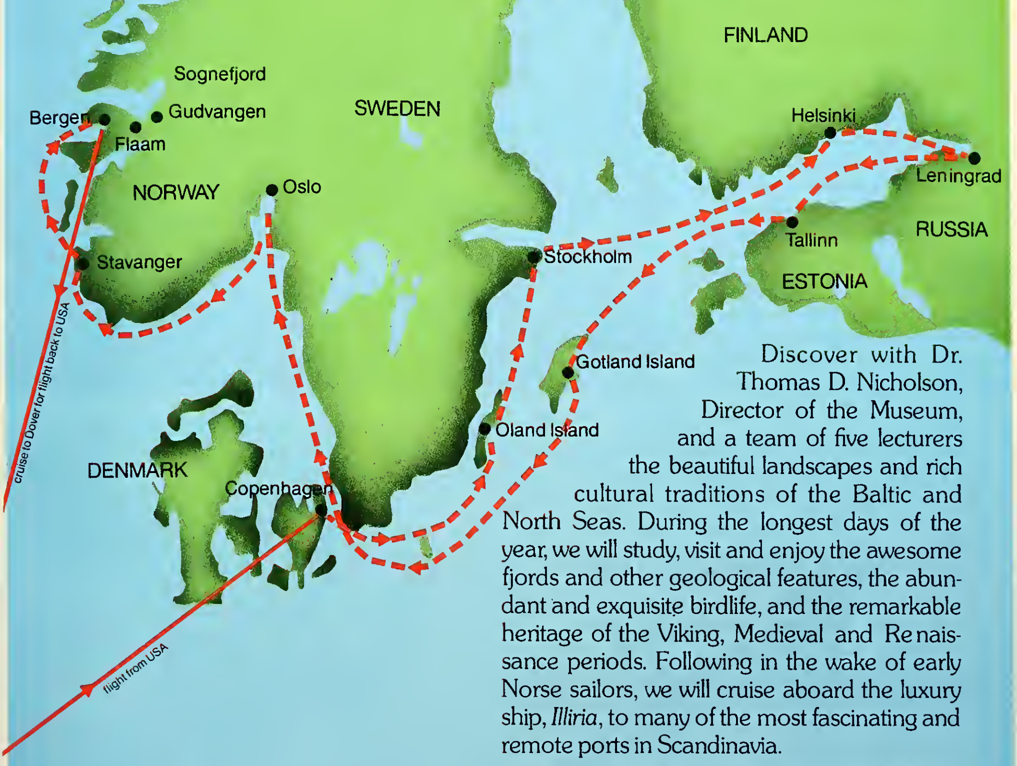
EASTERN
SMOKED MEATS
HAMS-BACON
DEL REY
HOT
TORTI
WIN
Snack Bars Coast To C

Craig Aurness

The American Museum of Natural History

Scandinavian Saga

July 28 to August 15, 1983


FINLAND
Sognefjord
Bergen
Gudvangen
Flaam
SWEDEN
Helsinki
Leningrad
NORWAY
Oslo
RUSSIA
Tallinn
Stockholm
Stavanger
ESTONIA
cruise to Dover for flight back to USA
Gotland Island
Oland Island
DENMARK
Copenhagen
flight from USA

Discover with Dr. Thomas D. Nicholson, Director of the Museum, and a team of five lecturers the beautiful landscapes and rich cultural traditions of the Baltic and North Seas. During the longest days of the year, we will study, visit and enjoy the awesome fjords and other geological features, the abundant and exquisite birdlife, and the remarkable heritage of the Viking, Medieval and Renaissance periods. Following in the wake of early Norse sailors, we will cruise aboard the luxury ship, *Illiria*, to many of the most fascinating and remote ports in Scandinavia.

For further information please send the attached coupon or call (212) 873-1440.

American
Museum of
Natural
History

Discovery Tours

Central Park at 79 St.
New York, N.Y. 10024
(212) 873-1440

Please send me complete information on the Discovery Tour to Scandinavia, July 28 to August 15, 1983.

Name (please print)

Address

City State Zip

ethnic California in a wonderfully vivid way. Down there on Broadway, where Hollywood directors like to shoot movies set in the "forgotten" California of the thirties and forties, directly across the street from the historic and incessantly photographed Bradbury Building, the market reveals various truths about the Golden State that one would hardly divine at the movies, on a tour of the homes of Hollywood stars, or window shopping among the chic boutiques of Rodeo Drive in Beverly Hills.

Aquí se habla español. They speak Spanish here, without even waiting to try English first. Oh, if you really can't manage, the shopkeepers will switch to serviceable English, but the basic idiom of the Central market is Chicano: confident, relaxed, sure that this is Hispanic turf.

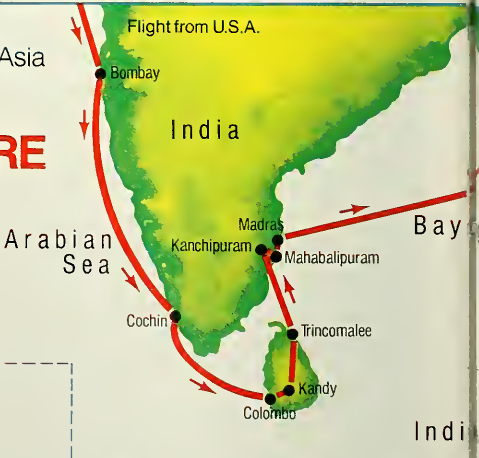
But that's not all. California's Oriental population, rooted here since railroading's dawn in the previous century, runs restaurants unconverted to the new gospel of torrid Szechuan regionalism. This is America, and they serve Chinese-American specialties in the birthplace of chop suey. Orientals also run the biggest health-food counter you are ever likely to see, complete with an on-duty acupuncturist and a section for taking a customer's blood pressure. At a tropical-juice bar across the

PLANTAINS
39¢
69¢

This winter you can discover the fabulous natural wonders and human achievements of Southeast Asia with the American Museum of Natural History.

INDIAN OCEAN ADVENTURE
January 21 to February 9, 1983
India, Sri Lanka, Burma, Thailand and Singapore

INDONESIAN ODYSSEY
February 3 to 24, 1983
Bali, Java, Komodo, Sulawesi and Singapore



American Museum of Natural History
Discovery Tours
Tel. (212) 873-1440
Central Park West at 79th St. New York, NY 10024

Please send an itinerary for the ☐ Indian Ocean Adventure
☐ Indonesian Odyssey.

Name (please print)

Address

City State Zip

Travel with numerous Museum lecturers to discover the paradise islands and cultures of Southeast Asia. (Your traveling faculty will include a geologist, naturalist, astronomer, anthropologist and ecologist.) Discover extrao dinary Hindu-Buddhist temples, exotic cultural performances, exquisite traditional crafts and artworks, and warm friendly peoples.

Relax on the Museum's exclusively chartered luxury vessel, the *Illiria*, as she cruises through

Johanna Hecht

DAHO PINTOS
10
5145
CHILE DE ARBOL

aisle, aficionados can order a five-vegetable "potassium" cocktail or mixtures of apple, alfalfa, grape, mango, tomato, papaya, boysenberry, grapefruit, pomegranate, pineapple, coconut, carrot, orange, celery, spinach, parsley, watercress, cabbage, passionfruit, beet, prune, garlic, or guava juice.

For 85 cents I bought a glass of papaya-banana-guava and felt much better about life, standing there by a portal open to the legendary California sun. Outside is a city street. But inside, a whole block deep, are festoons of fabulous produce just trucked in from the state's Central Valley, the most productive farmland on earth. From lettuce to kiwi fruit at $1.30 a pound, the bountiful greengrocers' and fruiterers' stands spill over with bright colors.

We expect good produce in California, and David can find as good near his house at the justifiably famous Farmer's Market. Connoisseurs will insist, correctly, that California kiwis may be bigger but not better than the New Zealand imports and that the giant Mexican papayas sold at the Central market for 59 cents a pound do not compare favorably with Hawaiian varieties flown in at great cost as far as New York.

But you will travel far before you find retail butchers with the variety of cuts routinely displayed at the Central market. In addition to all the usual pig parts familiar to anyone who shops in markets catering to those with a small budget and a southern background, here they also butcher the whole steer.

Dodging a cart full of beef hindquarters, I goggled at the whole beef heads complete with tongue (there were calves' and lambs' heads as well). And I was taken aback to see three of the four kinds of beef tripe. When they sell tripe at all, markets normally offer only the honeycomb tripe from the second stomach of the animal.

Cattle, as true ruminants, have four stomachs: the rumen (or paunch), the reticulum (or honeycomb), the manyplies (or psalterium, or omasum), and the abomasum (or read). All four, canonically, go into the classic French tripe stew, *tripe à la mode de Caen.* I knew from reading that they have different textures, smooth or leafy, but never having been able to buy tripe from more than the first two stomachs, I was out of my depth and couldn't tell which one was missing in this market. I also lacked the twelve hours of stove time necessary to cook *tripe à la mode de Caen.* But I urge readers in southern California to energize the butchers and encourage them to supply the missing fourth

Pagan
Burma
Rangoon
Thailand
Bangkok
ngal
Sea
China
South
Strait of Malacca
Penang
Malaya
ean
Singapore
Flight to U.S.A.
Flight from U.S.A.
Tana Toradja
Pare Pare
Sulawesi
Butung
Ujung Pandang
Java Sea
Indonesia
Flores
Komodo
Surabaya
Jakarta
Borobudur
Bali
Lombok
Flight to U.S.A.
Prambanam
Jogjakarta

opical landscapes
udded with smoking
olcanoes, beautiful coral reefs
nd beaches, and unique wildlife
uch as the Komodo Dragons).
his winter, discover paradise
ith the members and friends of
e American Museum of Natural History.

type of tripe so that a great Norman recipe can be prepared, perhaps for the first time, in a completely authentic manner in this country. It would certainly be a rare gastronomic occasion.

So too, for most of us, would be the chance to cook the beef testicles, big as mangoes, nonchalantly on sale next to more quotidian cuts. And for the truly experimental, there are beef hearts, feet, cheeks, and lips split open and bristling with white nodes resembling wheat grains. Presumably all these oddments find purchasers who know what to do with them, perhaps clever Chicanas who haven't yet forgotten what they learned in their home villages in Mexico.

Some of the grocers sell nothing but dried foods. These specialists purvey an encyclopedic stock of chilies. There are big, black-red, wide *anchos*; wizened, brownish *mulatos* for the Aztec turkey extravaganza *mole poblano de guajolote* (famous because the sauce contains some chocolate); smoky *chipotles*; long, thin, pointy *guajillos*, also called *traviesos*, or naughty, because of their sting and sometimes called *cascabel*; and the holy grail of chilies, the true *cascabel*, whose name means rattle. This small, spherical chili, which sounds like a rattle when shaken, is smooth, brownish red, and tastes nutty and relatively mild when toasted for the sauce that the intrepid cookbook author Diana Kennedy first encountered in the forests of the Yucatan and recommends for tacos. Finding the *cascabel* is usually hard but a cinch at the Grand Central Market.

Once you have the *cascabeles*, the same man will sell you Mexican dried shrimp, which have the skin and tail still on. This makes them hard to clean but they are tastier than the dried shrimp sold in Oriental markets. Whole Mexican dried shrimp are usually unavailable in this country. Once you have them and the *cascabeles*, nothing can stop you from duplicating the dried shrimp consommé that Diana Kennedy learned to make in Guadalajara from Clara Zabalza de García. This is the same Señora García who pickled chilies every year in pineapple vinegar.

I did not locate any pineapple vinegar in Los Angeles, but the Grand Central Market did tempt me with *nopales*, fresh, green, edible cactus "paddles" (see recipe), as well as bags of precut cactus *nopalitos*.

The real connoisseur will next make a beeline for the dairy counter, where they sell two varieties of cultured butter, slightly tangy and whipped in great mounds, and the creme fraiche snob will want to try a blind tasting of the three styles of Hispanic sour cream: Mexican, Guatemalan, and Salvadoran. The differences between them are slight but provocative. All three are more delicate than commercial sour cream.

I could go on about this extraordinary market, and I will, in next month's column, when I will talk about the Mexican restaurants there—undoubtedly the most authentic Mexican restaurants, humble though they are, that I have ever found in this country—and about why such brilliant food is so rarely prepared for public consumption even in Mexico.

Raymond Sokolov's new book, Fading Feast *(Farrar, Straus and Giroux), is a collection of food columns that first appeared in* Natural History.

Two recipes adapted from Diana Kennedy's *Recipes from the Regional Cooks of Mexico* (Harper and Row).

Nopales al Vapor Estilo Otumba

(Steamed Cactus Paddles Otumba)

2 tablespoons peanut or safflower oil
2 cloves garlic, peeled and finely chopped
1 pound nopales (either fresh with spines scraped off or canned but *not pickled en escabeche*), cut into small cubes
½ large white onion, finely chopped
2 chilies jalapeños or any hot, fresh green chilies, seeds and veins left in, thinly sliced
2 large sprigs epazote (seeds for this herb are available from Horticultural Enterprises, P.O. Box 34082, Dallas, TX 75234)
1 teaspoon salt or to taste

1. Heat the oil in a heavy pan until it smokes, then lower the flame and sauté the garlic, without browning, for a few seconds. Add the rest of the ingredients, cover the pan, and cook over a low flame, stirring the mixture from time to time until the nopales are almost tender. They should be very juicy at this stage.
2. Remove the lid from the pan and continue cooking over a slightly high flame until all the sticky liquid from the nopales has dried up—about 20 minutes, depending on how tender the nopales are.
3. To serve: Fill hot tortillas with the nopales and crumbled *queso fresco*, a soft, white, crumbly cheese for which farmer cheese is a good substitute. Or make a salad with lettuce, tomatoes, crumbled cheese, and seeded jalapeños *en escabeche* and dress with oil, vinegar, oregano, and chopped fresh coriander leaves. Or scramble eggs with nopales and chopped tomato. Use ½ cup of nopales for 2 eggs.

Yield: 2½ cups,
enough to fill 12 tortillas

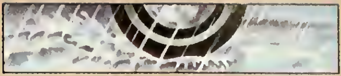
Señora García's Dried Shrimp Consommé

8 ounces dried shrimp
6 chilies cascabel
1 chili mulato
1 clove garlic, peeled and left whole
Roughly chopped coriander leaves
Finely chopped onion
Lime quarters

1. Cover the shrimps, uncleaned, with 2 cups of water and bring them to a simmer. Cook for 5 minutes, then remove from flame and set aside to soak for 5 minutes longer—no more, as the shrimps soon lose their flavor. Drain the shrimps and reserve the cooking water.
2. Remove the stalks from the chilies and veins and seeds from half of them. Put them into a saucepan, cover with water, and simmer for 5 minutes, or until soft (time varies, depending on how dry the chilies are). Remove from the flame and soak for about 5 minutes longer. Drain, discard the water in which they were cooked, and transfer to a blender jar with 1 cup of fresh water and the garlic. Blend until smooth. Pass through a fine sieve or food mill and set aside.
3. Remove the legs, tails, heads, and as much of the skin of the shrimps as possible and discard. Divide the cleaned shrimp into two equal parts. Roughly break up or chop one-half and reserve, then transfer the other half to the blender jar, together with the water in which they were cooked. Blend as smooth as possible.
4. Put the chili purée and the blended shrimps into a heavy saucepan, bring to a simmer, cook for about 3 minutes, stirring all the time and scraping the bottom of the pan. Add 1 more cup of water, bringing back to the simmering point, and continue cooking over a low flame for about 5 minutes. Add the shrimp pieces and continue cooking for 5 minutes, no longer. It should be a rather thick soup, but dilute if necessary. Serve in small cups and pass the chopped coriander and onion and lime quarters separately as a garnish.

Yield: 6 servings

FOR THE WET



FOR THE WHITE

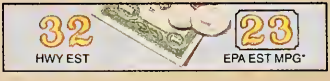
FOR THE WINDING

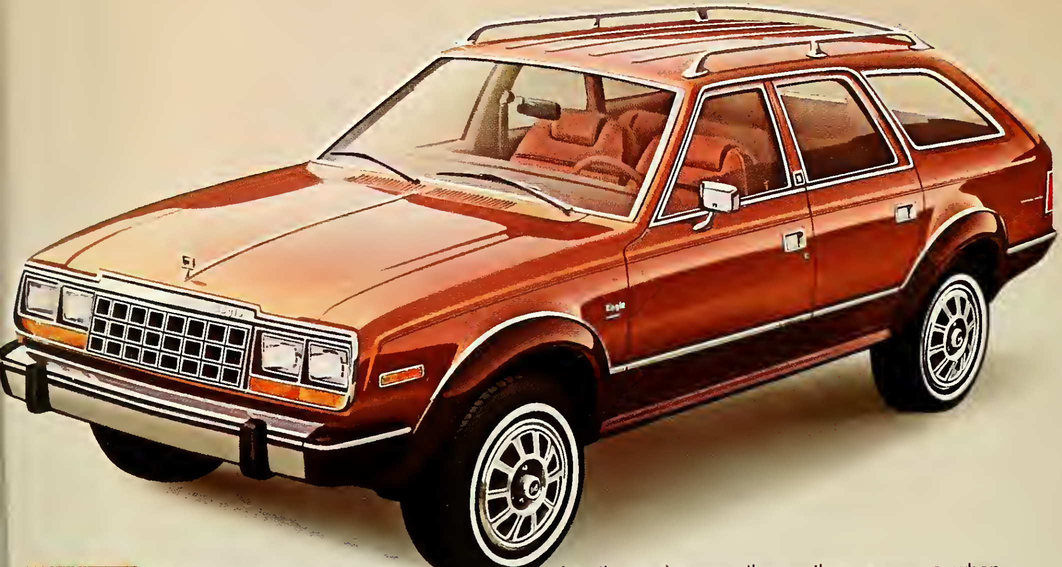
FOR THE WILD

FOR THE WARM

FOR THE WEEKEND

FOR THE WALLET





W is for Eagle Wagon. And for the wherever. Because Eagle is the only automobile in the world that lets you go from 2-wheel drive to full-time 4-wheel drive at the flick of a switch. 2-wheel drive for high mileage on the highway. 4-wheel drive for worry-free traction and security when the roads weave, the weather worsens, or when you just want to wander where there is no road.

And Eagle's well-appointed interior makes the going all the more wonderful. Why not see the 1983 Eagle Wagon today. Wherever you're going, whatever the weather, it'll fit you to a W.

SAFETY IS A SNAP

The 2-wheel/4-wheel drive EAGLE

FROM AMERICAN MOTORS

*Optional 5-speed stick. Use these figures for comparison. Your results may differ due to driving speed, weather conditions and trip length. Highway and California figures lower.

How dare The Glenlivet be so expensive?

How dare we place such a premium on our 12-year-old Scotch? The same reason vintage wines and fine cognacs are so expensive. Superior taste. Just one sip and you'll know that The Glenlivet has a taste that's decidedly superior.

The Glenlivet is Scotland's first and finest single malt Scotch. Nothing but 100% Highland malt whisky, distilled from natural spring water and fine malt barley, aged in oaken casks, just as it always has been.

Only our time-honored methods can truly achieve The Glenlivet's unequaled taste. A taste that sets it apart. Its smoothness, body and bouquet are qualities found only in this unique Scotch.

Of course, you may elect to purchase a good Scotch that's less expensive. But for a truly superior taste, you have to pay the greater price.

The Glenlivet

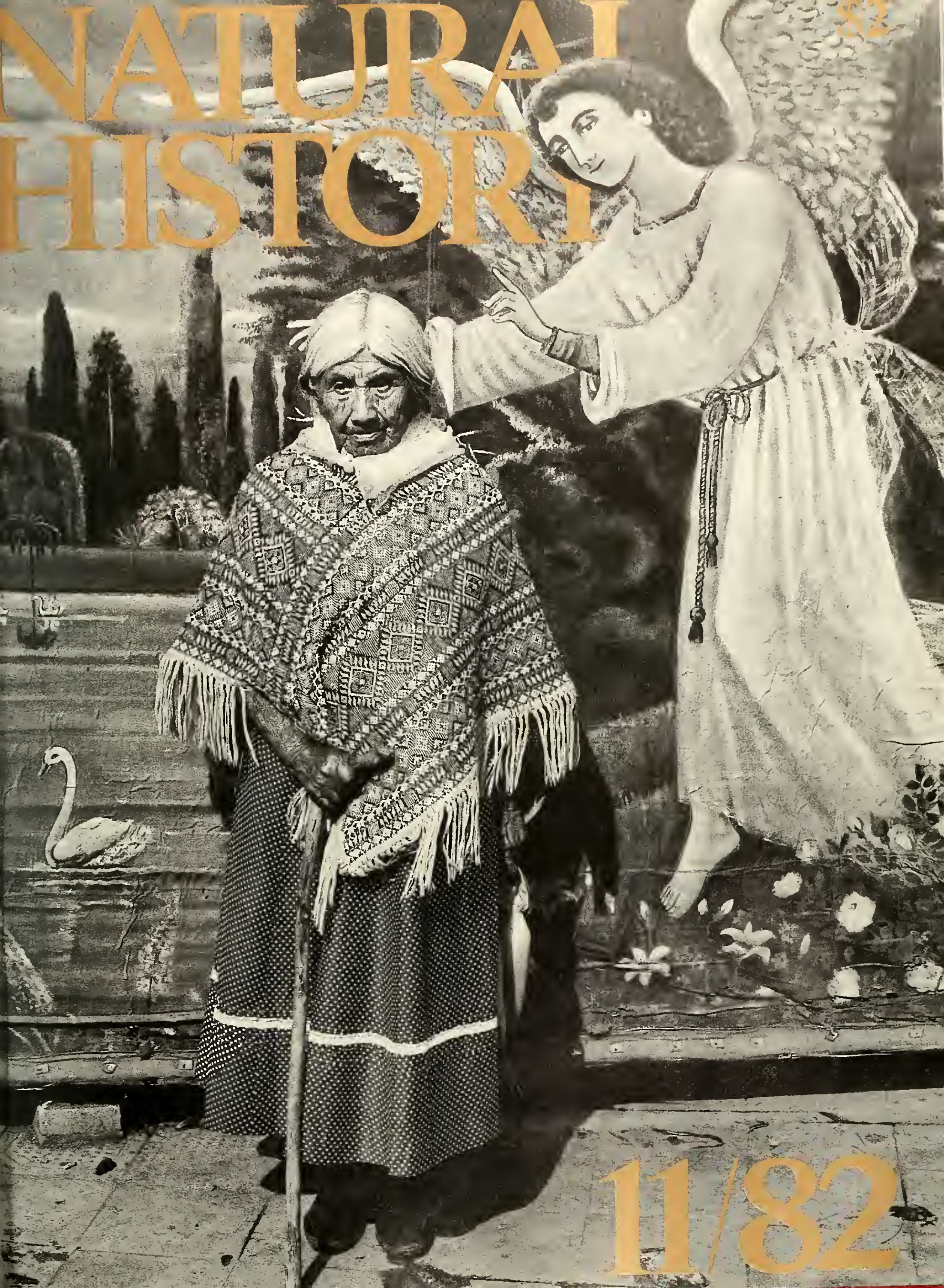
12-year-old unblended Scotch.
About $20 the bottle.

AGED 12 YEARS
BOTTLED IN SCOTLAND
The GLENLIVET
12 YEARS OLD
Unblended all malt Scotch Whisky
Distilled in Scotland by GEORGE & J. G. SMITH
U.S. IMPORTERS THE GLENLIVET DISTILLING COMPANY NEW YORK, N.Y.
12 YEARS OLD THE GLENLIVET SCOTCH WHISKY

© 1982 SEAGRAM DISTILLERS CO.

NATURAL HISTORY

$2



11/82

The Legend of Waterford®

Fire born
of fire.
The light
of the stars.
The light
of the sun.
The light of
a lamp
by Waterford.
A legend,
blown by mouth
& cut wholly
by hand,
with heart.
Visible proof
of Waterford's
conquest of
light.

In All Its Reflected Glory.

Illustrated booklet. Waterford Crystal,
225 Fifth Avenue, New York 10010.

Photo: Pesin

NATURAL HISTORY

Vol. 91, No. 11, November 1982

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director
David D. Ryus, Vice-President

2 **Authors**

8 **Catastrophe on Camels Hump** *Hubert W. Vogelmann*
Is a diet of acid rain causing sudden-death syndrome among New England's conifers?

18 **This View of Life** *Stephen Jay Gould*
Living with Connections

24 **Bios** *Robert E. Cook*
The Cold Facts of Winter Wheat

30 **Books in Review** *Luther P. Gerlach*
Environmental Putdown

34 **Letters**

38 **Celestial Events** *Thomas D. Nicholson*

42 **The Red Deer of Rhum** *Tim Clutton-Brock*
For some purposes, males and females should be considered different species.

48 **Beneath the Blanket Bogs of Britain** *Peter D. Moore*
Destruction of the environment is not limited to modern societies.
Look what prehistoric farmers did to Britain.

56 **Bird in a Cave** *David Whitacre and Devora Ukrain, photographs by Gene Groeschel*
Some Mexican swifts choose bizarre nest sites . . . for sound reasons.

62 **Los Ambulantes** *Photographs by Ann Parker, text by Avon Neal*
Itinerant photographers still roam the highlands of Guatemala.

70 **"It's, Like, Good Training for Life"** *David S. Surrey*
An anthropologist ventures into the exotic land of video game parlors and discovers a new subculture.

84 **A Home Computer Primer** *Antonia Stone*
A sensible guide for potential buyers.

94 **At the American Museum**
Ellis Hughes's Meteorite

98 **Additional Reading**

100 **A Matter of Taste** *Raymond Sokolov*
To Market, to Market . . . to Buy a Tortilla

Cover: *To commemorate her eighty-fourth birthday, a Guatemalan woman poses in front of a painted backdrop for an itinerant photographer. Photograph by Ann Parker. Story on page 62.*

Alan Ternes, Editor
Managing Editor: Erik Eckholm
(Judith Friedman, on leave)
Thomas Page, Designer
Board of Editors: Carol Breslin,
Sally Lindsay, Frederick Hartmann,
Vittorio Maestro, Rebecca B. Finnell
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
E. Kay Danzig, Art Asst.
Kay Zakariasen, Picture Editor
Ann Finch, Editorial Asst.
Lillian Berger

L. Thomas Kelly, Publisher
Bradford D. Smith, Business Manager
Ernestine Weindorf, Asst. to the Publisher
Carol A. Midkiff
Cary Castle, Circulation Manager
Jeff Pieper, Assoc. Circulation Mgr.
Ramôn E. Alvarez, Asst. Circulation Mgr.
Frank Stevens, Asst. Fulfillment Mgr.
Frederick E. Grossman, Production Manager
Debra Buck McCord, Asst. Production Mgr.
Elaine M. Callender, Advtg. Production Mgr.
Douglas J. Preston, Publications Manager

Natural History *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024.*
Subscriptions: $15.00 a year. In Canada and all other countries: $20.00 a year. Second-class postage paid at New York, N.Y. and at additional offices. *Copyright © 1982 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of* Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.* Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225

Subscription orders, change of address notices, undeliverable copies, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

A native of South Wales, **Peter D. Moore** is a senior lecturer in the Department of Plant Sciences at King's College in London. Interested since his undergraduate days in the development of wetlands, Moore has bored many bogs and employed pollen analysis to show how the activities of prehistoric peoples influenced the formation and spread of wetlands in Wales, Scotland, and England. He has also become involved in studies of the spread of deserts and, until recently, was part of a project in the Great Kavir desert in Iran. Currently, Moore is setting up a project in the Coto de Doñana in southern Spain to investigate the history of Mediterranean vegetation and its relationship to past land management.

In 1970 **Ann Parker** and **Avon Neal** were in Guatemala making rubbings at Tikal and other archeological sites when they first observed itinerant photographers working in a marketplace. They have since returned to Guatemala seven times, traveling extensively in the highlands where they have attended festivals in remote villages as well as those in the larger, more central towns. Ann Parker, a photographer and graphic artist, received a bachelor's degree in fine arts from Yale University. Avon Neal, a writer and graphic artist, earned his M.F.A. at the Escuela de Bellas Artes in Mexico. Primarily interested in folk art, Parker and Neal are studying primitive gravestones and adding to their archive of rubbings. They have collaborated on five previous books.

"As a high school sophomore on vacation in Mexico," writes **David Whitacre**, "I hired a kid to guide me to Sotano de las Golondrinas, then the world's deepest 'free-fall' pit cave." There, Whitacre witnessed the impressive morning flight of white-collared swifts out of the cave. Later, when he became an ornithologist, he returned to the cave to study the swifts. Now a graduate student in the Department of Zoology at the University of California, Davis, Whitacre recently completed research on the behavior and ecology of the bat falcon, a small, common bird of prey inhabiting neotropical lowland forests.

Coauthor **Devora Ukrain** has taken a break from her bird studies and is now a tour guide on trips down the Rio Grande. The trips, made in kayaks or rafts, offer her an opportunity to pursue a new interest: the use of local plants as medicines, in a historical and cultural context. She is a former research associate with the Chihuahuan Desert Research Institute in Alpine, Texas. Besides collaborating with David Whitacre on the white-collared swift study, she worked with him on the bat falcon project.

MAKE A FASCINATING DISCOVERY AT THE POST OFFICE.

Over 450 years ago, Ponce de León risked everything in his quest for the ultimate in riches–eternal youth.

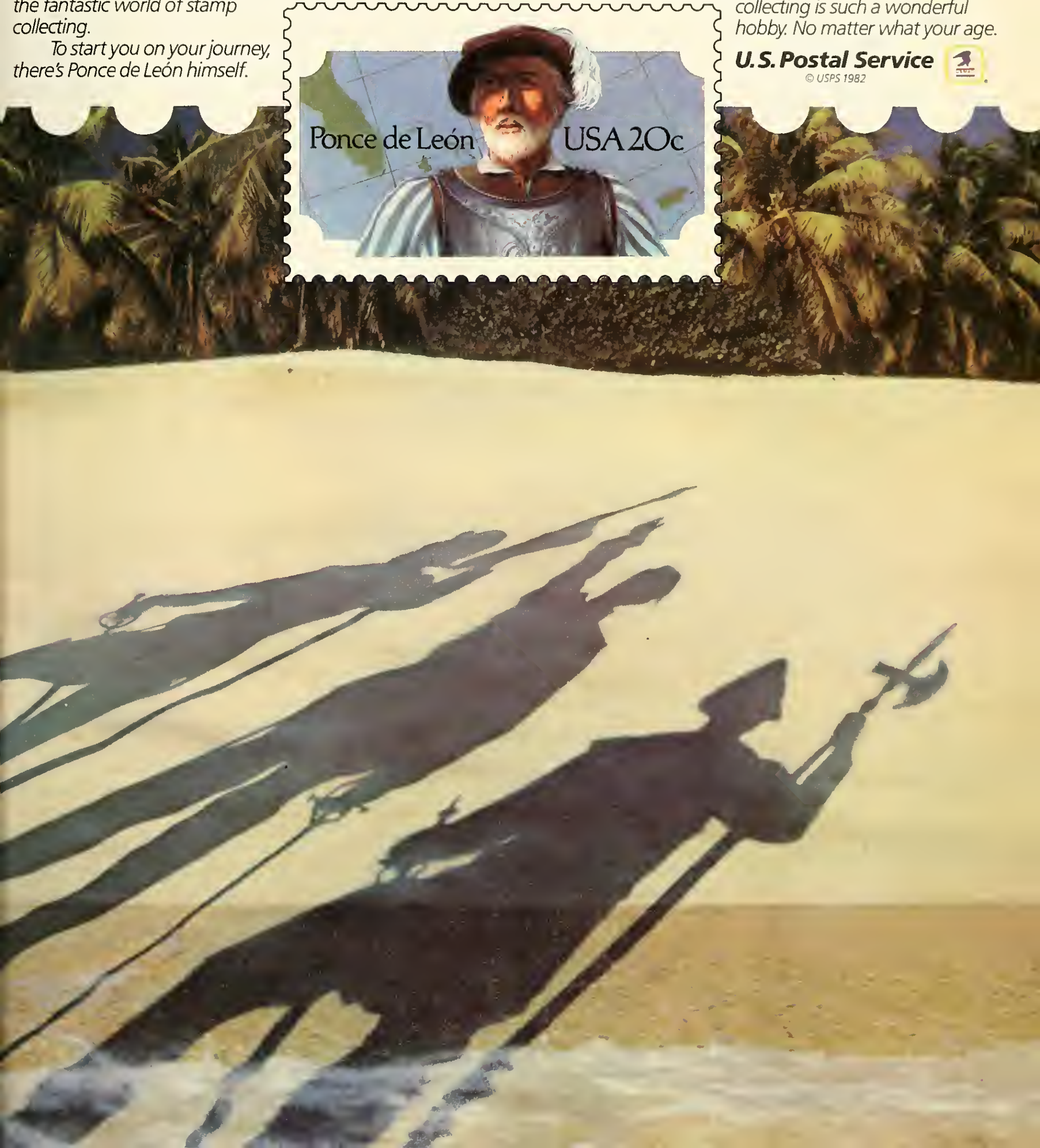
Today, of course, you can uncover a treasure trove of your own with a lot less effort. Because with one quick trip to the Post Office, you can be on your way to exploring the fantastic world of stamp collecting.

To start you on your journey, there's Ponce de León himself. He's on the newest U.S. Commemorative stamp. And every few weeks, you can look forward to another new issue that honors our country's great events. Heroes. And natural beauty.

So come to the Post Office. And discover why stamp collecting is such a wonderful hobby. No matter what your age.

U.S. Postal Service

© USPS 1982



Better Than Jogging

NordicTrack

Jarless Total Body Cardiovascular Exerciser Duplicates X-C Skiing for the Best Motion in Fitness

The enjoyable sport of cross-country skiing is often cited by physiologists as the most perfect form of cardiovascular exercise for both men and women. Its smooth, fluid, total body motion uniformly exercises more muscles and higher heart rates seem easier to attain than when jogging or cycling. NordicTrack closely simulates the pleasant X-C skiing motion and provides the same cardiovascular endurance-building benefits—right in the convenience of your home. Makes a year round, consistent exercise program easily attainable. Eliminates the usual barriers of time, weather, chance of injury, etc. Also highly effective for weight control.

Better Than Running
NordicTrack gives you a more complete work out—conditions both upper body and lower body muscles at the same time. Fluid, jarless motion will not cause joint or back pains as jogging or running often does.

More Effective Than Exercise Bikes
NordicTrack's stand-up skiing motion more uniformly exercises large leg muscles and also adds important upper body exercise. Higher pulse rates, necessary for building fitness, seem easier to attain because the work is shared by more muscle mass. The NordicTrack also keeps more muscles in tone.

Even Better Than Swimming
NordicTrack more effectively exercises the largest muscles in the body, those located in the legs and buttocks. These muscles' main function is to lift and propel the body in the standing position. However, when swimming, the body is supported by the water, thus preventing these muscles from being effectively exercised. The stand up exercising position on the NordicTrack much more effectively exercises these muscles.

A Proven, High Quality Durable Product
Ruggedly constructed, NordicTrack is quiet, motorless and folds compactly for storage. Separately adjustable arm and leg resistances. NordicTrack is in its 6th year of production and is used in thousands of homes and many companies. We manufacture and sell direct. Two year warrantee, 15 day trial period with unconditional return privilege.

For more information write or call
TOLL FREE 1-800-328-5888
8 AM-5 PM MON.-FRI.
PSI 124 L Columbia ct. Chaska, MN 55318
Minnesota 612-448-6987

An advanced research fellow with the Large Animal Research Group at Cambridge University, **Tim Clutton-Brock** is testing theoretical predictions in evolutionary ecology, using both field studies and syntheses of the literature on a wide array of species. The topics he is working on include the evolution of sex differences in body size, weaponry, and behavior; population density in mammals; and social organization. He states that "In many cases, the most useful approach to understanding why differences between the sexes have evolved is to treat males and females as if they belonged to different species." Clutton-Brock has chosen red deer as an ideal subject for his research interests, and has coauthored a book on these ungulates, *Red Deer: The Behavior and Ecology of Two Sexes*, recently published by Chicago University Press.

When he moved to New York City in 1972, **David S. Surrey** was drawn to the now old-fashioned "penny" arcades, and he has been intrigued by the transformation that has occurred since the introduction of video games. He has observed arcades in various places in the United States, hoping to find a game he is really good at. Surrey received his Ph.D. in anthropology in 1980 from the New School for Social Research, and a book based on his dissertation has just been published: *Choice of Conscience: Vietnam Draft and Military Resisters in Canada*. He is currently assistant director of the Public Policy Program at Saint Peter's College in Jersey City, New Jersey. His photograph was produced by a coin-operated machine in Pennsylvania Station, New York City.

ECUATORIANA

ECUATORIANA

All of South America. The easy way.

We make the business and vacation opportunities of South America easy to reach. And easy to enjoy. And we do it by giving you much, much more than a confirmed seat on a jet going south.

We've programmed our experience into the unique Ecuatronix computer complex. It is the information center that books and confirms the details of your travels all over the Southern Hemisphere. Not only on Ecuatoriana but on connecting local flights, land transportation, car rentals and accommodations if you wish, as well. So you know your travels in South America will be as smooth and comfortable as your flight.

On board, you'll be offered gourmet dining, in-flight entertainment and the prompt, professional attention of some of the most experienced flight attendants in all commercial aviation.

We bring you to the destinations direct or with easy connections from New York, Los Angeles and Miami.

Flying to South America has never been easier for you, your family and your company.

Call toll-free for information and reservations:
800-ECUADOR (800-328-2367).
In Miami, (305) 592-0200. In Canada, 800-268-7537.

ECUATORIANA
the airline of all the Americas®

Where is the Bell System going?

Nothing has done so much to change the world we live in as the telephone.

Yet the basic operating principles of the Bell System itself have changed very little over the past hundred years.

It was all because we had a single overriding goal: universal service. Dependable service at reasonable rates for everyone who wanted it.

And in order to achieve this goal, telephone exchanges were established as exclusive franchises and were permitted to operate without competition. But the government strictly regulated our rates and profits.

Today, 96% of the nation's homes have phone service.

So now America and the Bell System can change old goals for new ones.

The regulators and legislators of this country are looking more to the marketplace and competition–rather than regulation–to decide who will provide competitive services and equipment and how they will be priced.

The biggest force behind this change has been new technology which has changed the very nature of telecommunications.

We are on the threshold of a new era. The Information Age. The technology of communications has gradually merged with that of computers. And the marriage of these two technologies offers the potential for an impressive array of new customer services.

However, the blending of these two technologies has also blurred the boundaries between a traditionally regulated business–communications–and the unregulated data-processing industry.

This circumstance has led to some major rethinking of public policies on telecommunications.

Policies to which the Bell System must conform.

And in order to conform, the Bell System must change.

To begin with, the Bell telephone companies will have to be separated from their parent company, AT&T. Among other things, these local operating companies will continue to provide basic local service under state regulation, and they'll serve as the gateway to the new Information Age.

Because it is being thrust into a marketplace that is intensely competitive, AT&T–the parent company–is also going to change. The task of bringing these changes about is an enormous one. But we are determined to make the transition a smooth one.

AT&T will continue to create and provide new products and services to meet your changing needs. And Western Electric, Bell Labs and Long Lines will continue to remain vital parts of AT&T.

We want to keep our customers, shareowners and employees informed every step of the way. So along with your local Bell telephone company, we'll be talking with you in ads like this about varying aspects of the coming changes.

It's all part of the "Let's Talk" program set up by the Bell System.

Each ad will have a number to call: 1 800 555-5000.

There'll be somebody to talk to. Somebody to help you. Somebody to answer your questions. Somebody to get you information.

So call us. And we'll be talking to you.

Let's talk.

Bell System

Catastrophe on Camels Hump

Mounting evidence indicates that acid rain is killing trees in many forests of North America and Europe

by Hubert W. Vogelmann

Twenty years ago the evergreen forests on the slopes of Camels Hump, a high peak in the northern Green Mountains of Vermont, were deep green and dense. The red spruces and balsam firs that dominated the vegetation near the mountaintop thrived under high rainfall and cool temperatures. The trees were luxuriant, the forest was fragrant, and a walk among the conifers gave one a feeling of serenity—a sense of entering a primeval forest. The upper slopes of Camels Hump have probably never been lumbered. Some red spruces more than three hundred years old reached one hundred feet into the sky, dwarfing the younger spruces and firs below.

Today the red spruces are dead or dying and some firs look sick. Gray skeletons of trees, their branches devoid of needles, are everywhere in the forest. Trees young and old are dead, and most of those still alive bear brown needles and have unhealthy looking crowns. Craggy tops of dead giant spruces are silhouetted against the sky. The brittle treetops often break off, leaving only a jagged lower trunk with a few scraggly branches. Strong mountain winds overthrow many dead trees, tipping upward their shallow root systems along with chunks of the forest floor. As more and more trees die and are blown down, the survivors have less protection from the wind, and even they are toppled over. The forest looks as if it has been struck by a hurricane.

As the tree canopy opens, the once shadowed forest interior is flooded with sunlight. An invasion of new vegetation is encouraged, but there are no young spruces to be seen. A luxuriant growth of ferns and shrubs now covers the once bare forest soil, providing a verdant carpet that belies the devastation that has occurred.

The dying of spruces is not restricted to Camels Hump. Spruces are succumbing throughout the northern Green Mountains, especially on the windward slopes at high elevations. Dead and crown-damaged trees are common in the Adirondack Mountains in New York, in the White Mountains in New Hampshire, in the Laurentian Mountains in Quebec, and in the Appalachians as far south as West Virginia. It is a disaster that, in a few short years, has dramatically changed the appearance of high mountains.

Elsewhere in the Northern Hemisphere similar events are occurring. Between two and a half and five million acres of forest in Central Europe are reported to have been damaged. In West Germany alone, thousands of acres of spruce and fir forests have died, and some scientists claim this is only the first signal of an environmental disaster. At the edge of the Alps in Bavaria, a state of West Germany, a reported 13,500 acres of conifers are doomed. Conifers are not the only trees in trouble; the natural regeneration of beech in the Ruhr Valley has almost ceased. Similar accounts of embattled forests are coming in from England, France, Switzerland, Yugoslavia, Czechoslovakia, and Poland. Die-back patterns of spruce like that occurring in Vermont have been noted in Sweden.

As the reports accumulate, scientists are stepping up their efforts to determine what is killing the forests. Camels Hump is a unique resource for evaluating possible causes of the devastation. It is a mountain that has been intensely studied since the mid-1960s, when Tom Siccama, then a graduate student at the University of Vermont, made a thorough study of the mountain's vegetation, climate, and soils. By counting and measuring trees, he established a detailed data base that is of incalculable value today. Using the Siccama data for comparison, researchers at the University of Vermont have been able to document that nearly 50 percent of the spruces in the Camels Hump forest have died since 1965. Tree density, basal area (a measure of the amount of standing wood), and seedling reproduction also declined about 50 percent.

One possible explanation is that a disease or insects are destroying the red spruce, a species noted for being susceptible to such afflictions. In the late 1800s a beetle infestation caused widespread losses of spruces in the Adirondack Mountains and in New England. However, we have not found any insects on Camels Hump spruces that could cause the current mortality. Fungal growth is found under the bark at the bases of the dying trees, but plant pathologists believe these fungi are secondary invaders and only attack trees that are already dying.

Long-term population cycles must also be considered since large shifts in population numbers occur in many species over time. Fir trees, for example, sometimes grow in thick stands and mature as a group. A few years after they reach maturity, they die and the fir forest collapses. But the dying spruces do not fit this pattern: trees of different ages spread out over a wide area are dying all at the same time.

Another possibility is that the climate has changed recently and the effects on spruce are just now being realized. There was a period of dry years in the 1960s and again in the 1970s. Perhaps the effects of drought are now showing up in the

THIS CHEVROLET IS SO VERSATILE IT'S PART WAGON, PART SCHOOL BUS, PART SNOWMOBILE, PART SPORTY CAR.

No import gives you the room and versatility of Chevrolet's front-wheel-drive, five-passenger Citation Hatchback.

There are 95 cubic feet of space inside a Citation. More than a Honda Accord, a VW Jetta, a Nissan Stanza DLX or Toyota Cressida. Yet Citation gives you small-car mileage along with its mid-size room: 42 Est. Hwy., 27 EPA Est. MPG.*

Chevy Citation is an agile car with a decidedly sporty feel. An electronically fuel-injected 2.5 Liter 4-cylinder engine is standard. Chevy's legendary F41 Sport Suspension is available on all Citation models as is—for the first time—the high-output 2.8 Liter V6. And, whichever way you go Citation, you get front-wheel-drive traction to help make winter a whole lot easier to pull through.

Chevrolet's versatile Citation. Any wonder it's outsold all other front-wheel-drives over the past three years combined?

Come drive it. If you haven't seen your Chevrolet dealer, you're not ready to buy a new car.

GM

Citation 4-Door Hatchback: It does many things many cars can't.

*Use estimated MPG for comparisons. Your mileage may differ depending on speed, distance, weather. Actual highway mileage lower. Some Chevrolets are equipped with engines produced by other GM divisions, subsidiaries, or affiliated companies worldwide. See your dealer for details.

USA-1 IS TAKING CHARGE

Chevrolet

CITATION · CELEBRITY · CAVALIER · CHEVETTE · CAMARO · MALIBU · MONTE CARLO · CAPRICE · CORVETTE

David Like

The gray skeletons of dead and dying spruce trees increasingly blight the upper slopes of Vermont's Green Mountains, above, and other northeastern ranges. A variety of clues implicate acid rain as the probable killer.

spruces, which grow best in wet and cool climates. Periods of drought occur fairly regularly, however, and are a normal part of long-term weather cycles. Many of the dying trees are three hundred years old, and some are even older. It seems unlikely that there have been any changes in climate that these older trees have not confronted before.

With many of the normal causes of tree mortality ruled out, suspicions have turned to one ingredient of our environment that has been introduced in the last thirty years—acid rain. Could acid rain be responsible for the killing of our forests? That acid rain has damaged or destroyed fish life in hundreds of lakes in Europe and North America has been firmly established, but proving its impact on forests is extremely difficult because forests grow slowly and are subject to a wide variety of influences. Nevertheless, mounting evidence indicates that acidic rainfall may be impairing forest productivity and killing trees in several regions.

Acid rain is a modern-day product—a result of the industrial revolution and of all the tall smokestacks and car exhausts that are part of an affluent society. The burning of fossil fuels produces millions of tons of sulfur and nitrogen oxides. Spewed into the atmosphere, these gases combine with water to make sulfuric and nitric acids, which continually fall on the leaves of plants, enter the soil, and are added to lakes and streams. Just how acidic the rain has become can be determined by comparing it with the rain of preindustrial times. Frozen deep within the Greenland icecaps are annual layers of precipitation spanning thousands of years. Studies of samples of this frozen rain have revealed that the rain now falling in the northeastern United States is at least thirty to forty times more acidic than preindustrial rain. Compounding the problem of acidity, smokestacks and car exhausts push other pollutants into the atmosphere—lead, zinc, copper, vanadium, and cadmium. These heavy metals are all toxic to plants, altering the permeability of cell membranes and interfering with the exchange of substances vital to the life of cells.

In the United States, acid rain is especially common in the Northeast, but the area it affects has enlarged dramatically since the 1950s and now stretches from the Mississippi River to the Atlantic coast; much of eastern Canada is affected too. Acid rain is now also common in California and the Rocky Mountains. It is well documented throughout Europe and has recently been reported from China.

Acid rain knows no political boundaries. Pushed by the wind, polluted air masses dump acid rain and heavy metals on whoever is downwind. What originates in the stacks of coal-burning plants in the Midwest falls on New England and eastern Canada. What is born in Canada gets exported to the eastern United States. In Europe, acid rains originating in England, France, and Germany eventually drop in Denmark, Norway, and Sweden. As the biological and economic impacts of acid rain become more clear, political clashes between countries will intensify.

While politicians fret about whose pollution is crossing whose borders, scientists from different parts of the world are gradually piecing together the puzzle of just how acid rain may harm the regions it falls on. New England, for example, is at the end of an enormous, heavily polluted airshed fed by prevailing westerly winds

The renowned illustrator
of "Little Women"
creates her first porcelain sculptures ...

Amy by Tasha Tudor

Inaugurating Tasha Tudor's first
collection of porcelain sculptures.
Individually crafted, hand-painted
and issued in limited edition.
Art of enchanting beauty,
at the very attractive price of $75.

In today's world of fine book illustrators, there is one name that stands out among the rest—*Tasha Tudor.* An artist who, for almost fifty years, has been capturing the hearts of millions with art that is happy, innocent and filled with old-fashioned charm. With delicate use of colors and a wealth of detail, her illustrations create a magical world of make-believe with characters as loveable as they are unforgettable.

Now, to celebrate the 150th anniversary of author Louisa May Alcott's birth, Tasha Tudor has created her very first works in porcelain. A collection of limited edition "Little Women" sculptures that are sure to be of exceptional interest to collectors.

"Amy" portraying Louisa May Alcott's charming, blue-eyed beauty, inaugurates the collection. Crafted in fine, hand-painted porcelain, it is a thoroughly delightful work of art. And it will be issued at the very modest price of just $75—which may itself be paid in convenient monthly installments.

The figure that Tasha Tudor has designed is so vivid, so alive, it's as if "Amy" had invited you into the pages of "Little Women" to come pay a special visit. There she sits with bent head and dreamy eyes fixed on the sketchpad in her lap. From her golden curls cascading down her shoulders, to the ruffled pinafore she wears as an artist's smock—she's the very vision of loveliness. A captivating and compelling sculpture as charming and full of grace as Louisa May Alcott's young artist.

To ensure that every small detail of Tasha Tudor's art—every nuance of expression—is faithfully captured, each imported sculpture will be individually crafted by master porcelain artisans. Each sculpture will be hand-cast ... hand-assembled ... and meticulously hand-painted with uncompromising care.

In the tradition of classic works in fine porcelain, "Amy" will be issued in a single limited edition, reserved exclusively for those who order from the collection by November 29, 1982—the 150th anniversary of Louisa May Alcott's birth. When all valid orders from these individuals have been filled, the edition will be permanently closed.

"Amy" will bring her own personality and charm to your home and any room in which you choose to display her. And in time to come, this engaging work of art is likely to become a treasured family heirloom, lovingly passed on from mother to daughter.

To acquire your own hand-painted fine porcelain sculpture of "Amy" by Tasha Tudor, it is important to act promptly. Please be sure to mail the accompanying advance reservation application by November 29, 1982.

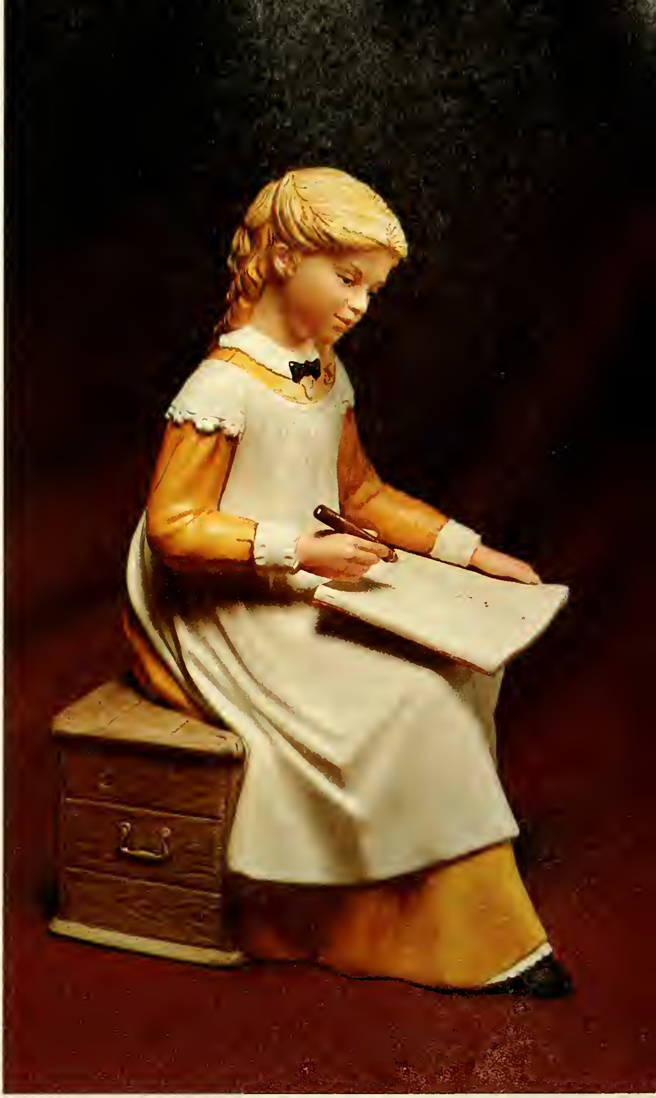


Figure shown actual size of 5¼" in height.

© 1982 FP

ADVANCE RESERVATION APPLICATION

Amy *by Tasha Tudor*

Franklin Porcelain
Franklin Center, Pennsylvania 19091

Valid only if postmarked
by November 29, 1982.

Limit: One sculpture per person.

Please accept my reservation for "Amy" by Tasha Tudor, to be handcrafted for me in fine, hand-painted porcelain.

I understand that I need send no money now. I will be billed in four equal monthly installments of $18.75* each, with the first payment due in advance of shipment.

**Plus my state sales tax, and $3. for shipping and handling.*

Signature____________________
ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE.

Mr.
Mrs.
Miss____________________
PLEASE PRINT CLEARLY

Address____________________

City____________________

State, Zip____________________

that carry pollutants for hundreds of miles. High mountains in the Northeast cause the air masses to rise and cool, forming precipitation in the form of rain, hail, snow, sleet, or drizzle—all acidic. To make matters worse, the affected area is largely composed of young glacial soils, which are naturally acidic and devoid of the lime that could neutralize the sulfuric and nitric acids. Consequently, the acids combine with valuable nutrients, such as calcium, magnesium, sodium, and potassium, and leach them at an accelerated rate from already poor soils.

Some of the acid rain falls directly on the leaves of plants. There, too, it leaches away important substances needed for healthy growth, including potassium, sugars, proteins, and amino acids. Severe acid rains can even damage the waxy covering that protects leaves from desiccation and attack by fungi and bacteria.

Forests in the north country get an additional acid boost in the spring. Snow and ice, which accumulate for three or four months in the winter, release acid in a sudden burst during the spring thaw, producing a strong shock to tree root systems as the acid percolates into the soil. Fogs that sweep through the forests on the mountaintops are often one hundred times more acidic than normal rain, more than twice as acidic as acid rain.

High elevation spruce-fir forests, such as the ones we've been studying on Camels Hump, receive much more rainfall and fog than do forests at lower elevations. Forests at 3,500 to 4,000 feet in the northern Green Mountains get about twice the annual precipitation of Burlington, Vermont, which is thirty miles away at an elevation of 400 feet. The acid load is more than doubled, and so is the dose of toxic heavy metals. Moreover, spruce-fir forests at high elevations are growing in a severe subarctic climate with a short growing season and on soils that are thin, nutritionally depauperate, and naturally acidic. These trees, already growing in a harsh environment, may be highly susceptible to the added insults of acid rain and heavy metals.

But are trees in marginal environments the only vulnerable plants? Perhaps the dying spruces are the equivalent of the canary in the mine, a warning of imminent danger to trees that are now growing on more favorable sites. Accumulation of heavy metals and steady acid rains may eventually tip the balance of life, a balance that may be more delicately poised than we realize.

This theory is now being tested in laboratory experiments and fieldwork at the University of Vermont. A team of botanists is examining the effects of acid rain on the growth of trees and other kinds of plants. We use information gathered from field studies as a basis for experiments performed under controlled laboratory conditions to determine the extent to which various concentrations of acids and heavy metals harm plant growth. Sometimes, our laboratory findings send us back into the field in search of corroborating evidence.

One of the most interesting experiments in our laboratory has demonstrated that exposure to either acid rain or a heavy metal will stunt plants, but when the two are combined (in the form of acidified water to which small amounts of aluminum, copper, lead, or zinc have been added), all plants show sharp declines and the result can be lethal, suggesting a strong synergistic effect. We have carried out tests on many kinds of plants—mosses, bacteria, algae, and fungi, as well as trees. All plants show sharp growth declines. A common moss used in our laboratory experiments was greatly suppressed under simulated field conditions, and comparative field studies reveal that since the mid-1960s, the coverage of mosses in the Camels Hump forests has declined by 50 percent.

Fungi are another group of plants tested in the laboratory. Necessary to the maintenance of a healthy forest, fungi decompose the piles of leaves and branches that continually fall to the forest floor, recycling nutrients the trees need for continued growth. Healthy tree growth is often also dependent on a complex symbiotic fungus–root association known as mycorrhizae, and the destruction of the sensitive fungal component alone is enough to weaken the tree. Although our researchers have pulled many small spruces from the ground on Camels Hump, we have not been able to find the tiny growths on young roots that are a sign of the mycorrhizal association.

A recent study being done in our laboratory on the wood of spruce trees may provide a clue to one of the most important effects of acid rain. Cores taken from old trees give a record of the ages and yearly growth rates of the trees. Sections from the wood cores representing years from the late 1800s onward are analyzed chemically. Preliminary core samples indicate that the content of aluminum in the wood changed very little from the early 1900s until about 1950. At that time, the period associated with the beginnings of acid rain, the concentration of aluminum increased dramatically and in some samples was three times higher than before.

Unlike airborne metal contaminants, such as lead, zinc, copper, cadmium, and vanadium, inorganic aluminum is already present in the soil, in an insoluble form. Acid rain appears to combine with aluminum, transforming it into a soluble form capable of being taken up by roots. This aluminum is highly toxic, and as it invades a tree, it kills the young roots that supply

David Like

Mountain winds overthrow many of the newly dead trees on Camels Hump in Vermont, ripping up the forest floor. As more trees die and fall, the survivors have less protection from the wind and they too are often toppled.

AN UNBIASED GUIDE TO TELEPHONE ANSWERING MACHINES

—And How to Save Money on One of the Best

If you seriously want to buy an answering machine, don't make your choice based on misinformation. All answering devices are not alike. So don't get stuck by getting too little. Or paying too much. Most of all, be familiar with the differences among machines. We hope this guide will cut through the confusion and explain some crucial points. Look for these most-asked-for, practical features:

LIMITED VOICE ACTUATION The caller's voice signals the machine to start taking a message. And when the caller stops talking, the machine stops recording. Records up to 35 seconds; no wasted tape, no intervals to wait for when you play back your calls. An "intelligent" unit recognizes a hangup within seconds so you don't have to listen to an annoying 1-minute dial tone on playback.

INCOMING-CALL MONITOR Let the machine "pick up" the phone for you. You'll hear the caller's voice over a built-in speaker without lifting the receiver. Then decide whether to get on the phone or just let the machine take a message.

EASY ONE-BUTTON RECORDING
Just push a button and record your outgoing greeting into a built-in microphone. Nothing to "hook up" so it's easy to change your message whenever you feel like it or to impress callers with a customized greeting.

DUAL CASSETTES A 2-cassette machine records your voice on one cassette tape and the incoming calls on a separate tape, a big improvement over many single-cassette units which require you to pre-record your outgoing messages twenty or thirty times and force you to listen to your message before each incoming call on playback.

REMOTE Phone in to your answering machine from any phone, anywhere, and hear your messages played back to you after you signal into the mouthpiece with a pocket "beeper." The best machines also allow you to signal the unit to repeat those messages.

SAVE OR ERASE REMOTELY
After you call in, you can signal your machine via beeper to either save your messages for the future or to rewind to the beginning and erase old messages as new ones are received.

RECORD 2-WAY CONVERSATIONS
Simply turn a knob to automatically record what you and the other party say.

MESSAGE MINDER REMOTE

WHICH MACHINE HAS ALL THESE FEATURES?

Well...our favorite, the MESSAGE-MINDER REMOTE, has everything—and can be yours at a hard-to-believe $169.95 through The Right Answer. We know you won't find another answering machine with all these features for less than $250. And some competing machines sell for $350–$400. So send the coupon now with $169.95 or call us collect and start enjoying the benefits of a versatile answering system plus your FREE push-button Trendline phone.

CHECK THESE MESSAGE-MINDER FEATURES

- ✓ FREE beeper so you can receive your messages over any phone in the world.
- ✓ Can be set to answer your phone after any number of rings.
- ✓ Full remote call-in capability.
- ✓ Limited voice actuation for efficiency and convenience.
- ✓ Dual-cassette operation makes it easy to change your message.
- ✓ Instant hookup to your phone.
- ✓ Legal for use with any home or office phone. FCC approved.
- ✓ Instantaneous, accurate micro-computer circuitry.
- ✓ Can be used as a handy dictating machine.
- ✓ Can be set to record 2-way conversations.
- ✓ Has time-saving scanning fast-forward switch.
- ✓ Convenient Quick-Erase feature.
- ✓ $100 SAVINGS over comparable machines. FOREIGN VOLTAGES AVAILABLE

FREE PUSH-BUTTON TRENDLINE PHONE WITH YOUR ORDER

Yes, you read it right. With every Message-Minder Remote that you order, you get a modern, lightweight, full-featured Trendline push-button telephone FREE!

- ✓ Push-button operation with any phone system, whether you now have rotary dialing or Touch-Tone. Can be used as a main phone or as an extension.
- ✓ Automatic redial after busy signal.
- ✓ Built-in "HOLD" button included.
- ✓ Plugs in with no additional wiring.
- ✓ On/Off switch for ringer if you don't want to be disturbed.

THE RIGHT ANSWER

111 Third Avenue
New York, NY 10003

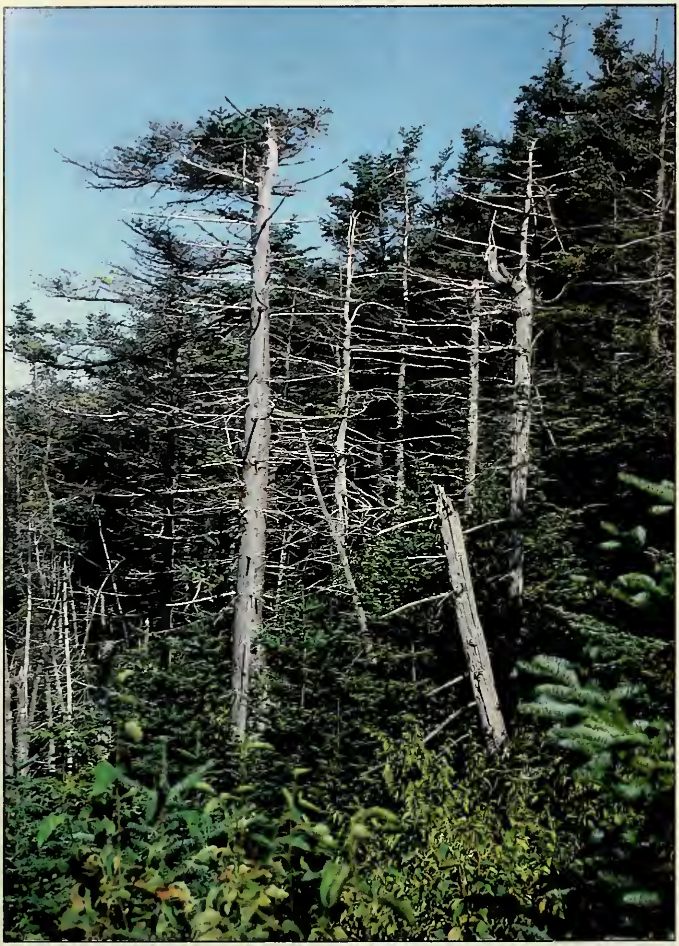
FREE PHONE!
ONE-YEAR WARRANTY
TWO-WEEK TRIAL PERIOD

AMERICAN EXPRESS MasterCard VISA

ORDER BY PHONE
Call 24 hours a day
Call collect for "Order Dept." 212/734-4455

TO: THE RIGHT ANSWER, 111 Third Avenue, New York, NY 10003
Enclosed is $________ for ____ (QTY) MESSAGE MINDERS
@ $169.95 including FREE phone (Additional phones $29.95 each.)
Shipping & Insurance $2.95 per unit. N.Y. residents add tax.
Charge my: VISA ☐ MASTER ☐ AM EX ☐ Phone # ________
Card # ________________ Exp. Date ________
Name ____________ Signature ____________
Address (Not P.O. Box) ________________
City ____________ State ______ Zip ______

David Like



Nearly half the spruces on Camels Hump have died mysteriously since 1965. Suspicions center on the high acidity of New England's precipitation, a consequence of pollution emitted hundreds of miles away.

the tree with water. The tree's water uptake is reduced, causing needles and branches to dry and wither. An experiment carried out in our laboratory demonstrates that spruce trees growing in acidified water to which small amounts of aluminum or cadmium have been added do indeed show a reduction of water uptake. The laboratory plants soon take on the look of the dying spruces in the forest.

Critical work on the effects of aluminum and other aspects of acid rain is also being done by Bernhard Ulrich, a soils scientist at the University of Göttingen, who called the world's attention to the death of spruce and beech trees in Germany. Ulrich estimates that 70 percent of Germany's forests are affected and attributes the cause to acid rain originating in the heavily industrialized Ruhr Valley. Based on studies made over the last sixteen years, he theorizes that the bark and foliage of trees collect low concentrations of sulfates as dry deposition. Acid rains flush the dry acid material from the trees, increasing the acidity of the water reaching the ground. As a result, the levels of soluble aluminum in the soil go up, more and more roots are destroyed, the trees take up less water, the foliage becomes brown, the leaves drop off, and the trees die.

Most of the reports so far of trees presumably damaged by acid rains involve coniferous species. In North America, the spruces are the most dramatic example, but several other conifers are in trouble. Scientists at the University of Pennsylvania and Yale University have produced good evidence that the decline of some coniferous species in the New Jersey Pine Barrens is linked to an increased acidification of the ecosystem. Measurements of the growth rings of pitch, shortleaf, and loblolly pine reveal that these species have experienced substantial and sustained decreases in annual growth rates in the past twenty to thirty years. Black spruces in Maine show a similar downward trend in growth rates.

Conifers seem to be more susceptible than hardwoods to airborne pollution, in part because their needles are exposed year-round to acid rain and other noxious substances. Deciduous trees, which drop their leaves in the fall, are given a respite to foliar attack during winter months. Nevertheless, hardwoods may not be immune. From 1965 to the present, the period when the spruces showed a sharp decline, the basal areas of sugar maple and beech growing on the lower slopes of Camels Hump dropped significantly, those of the maples by 15 percent and the beeches by 30 percent. Even more alarming is that the number of maple seedlings and saplings dropped 57 percent. If such losses in only a few years are representative of a general decline in forest productivity, the economic consequences for the lumber industry will be staggering.

In all these grim reports, acid rain is implicated as the villian, but most of the evidence is still circumstantial. Forest environments are complicated, and so are the effects of acid rain. Some red spruce stands in the Northeast, especially those at low elevations, have escaped damage. Controversial studies in Scandinavia indicate that the acidity actually encourages tree growth through the fertilizing action of nitrogen and sulfur. Some Scandinavian scientists claim that their forests now benefit from these added nutrients. They note, however, that the forest soils are losing calcium and magnesium at a fast rate and that any gains may well be short-lived. The puzzle obviously still has many missing pieces, but bit by bit the emerging picture shows acid rain to be damaging to forests of many kinds. In some regions, such as Camels Hump, it could be a killer.

Hubert W. Vogelmann is professor of botany and chairman of the Department of Botany at the University of Vermont in Burlington.

FORWARD
POWER
OFF FAN LO HI
REVERSE
TIMER
OFF F • • • S
SELECT
REMOVE LENS BEFORE USING VIEWER
FOCUS
Kodak CAROUSEL 5600 projector
CAROUSEL 5600 projector
KODAK EKTANAR C
102mm f/2.8 Projection Lens

STATE·OF·THE·ART

The Kodak Carousel 5600 projector

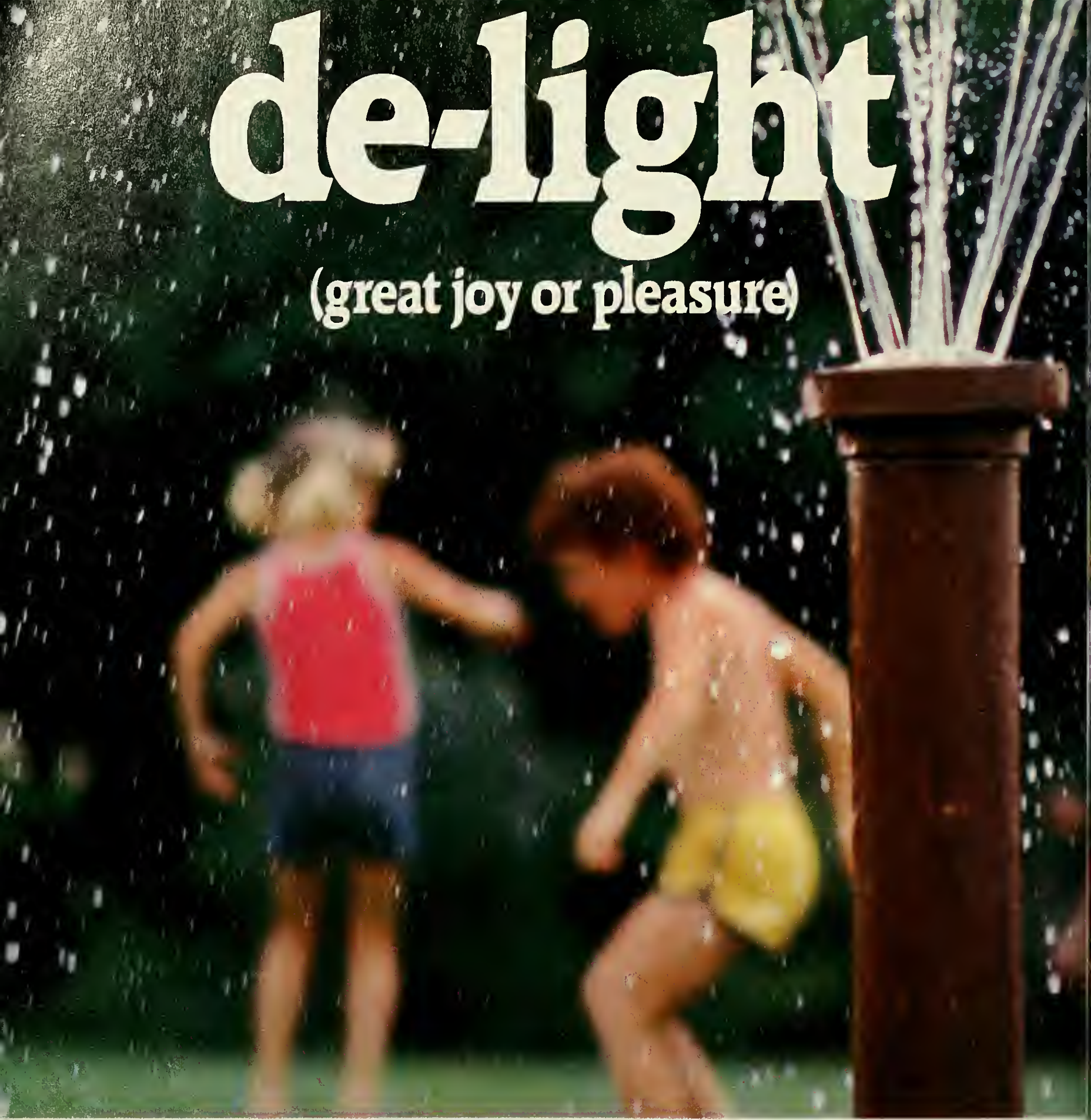
Slide viewing with a Kodak projector has never been as easy as it is now with the Kodak Carousel® 5600 projector. Because no other slide projector has all these features. Our exclusive Slide-Scan™ built-in screen, for example, can turn any room in the house into a screening room. And no matter what room you're in, the illuminated control panel and built-in reading light eliminate fumbling around in the dark. There's also a lamp that lasts up to 70 hours. Plus our auto-focus feature that helps make the slide you're projecting look crisp and sharp. And, amazing but true, the projector even turns the lights off. The Kodak Carousel 5600 projector. It's a gift anyone would love.

From Kodak
The Pro in Projectors

© Eastman Kodak Company, 1982

de-light

(great joy or pleasure)



In today's demanding, high-pressure world, moments of pure pleasure are an essential part of a healthy lifestyle.

Providing those moments is Bally's business.

Through its broad involvement in the amusement industry, Bally puts pleasurable experience within easy reach of people everywhere.

A visit to one of Bally's Six Flags theme parks can offer the entire family a delightful day-long diversion from life's serious business.

And Bally's family amusement centers, family amusement restaurants and electronic amusement games offer other convenient recreational opportunities to satisfy a wide variety of tastes.

Today, more than ever, experiences of sheer delight are an essential part of the good life.

And those experiences are the heart of Bally's business.

© Bally Mfg. Corp.

The Arts Lottery
WIN UP TO $200,000
$5
BASEBALL
$50,000
Aces 3

Fun is our business

Scientific Games Inc., Bally's wholly owned subsidiary, produces lottery games and tickets for most of America's state lotteries, which generate revenue used to support such important programs as mental health, aid to the elderly, and education.

Bally®

Bally Manufacturing Corporation
2640 W. Belmont Avenue
Chicago, Illinois 60618

Living with Connections

Are Siamese twins one person or two?

by Stephen Jay Gould

La Grand Galerie of the Muséum d'Histoire Naturelle in Paris has been closed for fifteen years. This great space, supported by iron and roofed in glass, is no longer structurally sound. Like the capacious nineteenth-century railroad stations that served as its model, La Grande Galerie has passed into history. Its exhibits, too, reflect the thoughts and concerns of another age, the expansive and aggressive Victorian era that took so seriously, as a guide for collection and display, the words of Genesis (1:22): "Be fruitful and multiply, and fill the waters in the seas, and let fowl multiply in the earth." If modern museums emphasize intimacy, good lighting, tasteful display, and well-chosen words, their Victorian predecessors judged quality by quantity and crammed as many large animals as possible into their vast open spaces. At Lord Rothschild's museum in Tring, the stuffed zebras are supine, so that four tiers, rather than two or three, may be fitted from floor to ceiling.

La Grande Galerie is the granddaddy of them all. Built in 1889, and unchanged since, its skeletons and stuffed animals occupy every available inch. The great central pyramid almost reaches the high glass ceiling. One side is all zebras, another all antelopes; six giraffes crown the summit. The dust is thick, the hall dark and empty; eerie silence marks a dingy majesty.

The companion hall, La Galerie d'Anatomie Comparée, is smaller, well lit, and still open. Its style is identical—row upon endless row, tier upon tier of blanched skeletons. I wandered up and down the aisles, marveling at a long row of walruses and five superposed tiers of monkey skulls. Then I passed by cabinet 106 and stopped short. It contains a sideshow to offset the neighboring forest of sleek lions, and to remind complacent Victorians that nature can be capricious and cruel, as well as bountiful. Cabinet 106 holds a collection of teratological specimens, skeletons of deformed and abnormal births. Most are human and most represent that puzzling and frightening phenomenon of joined birth, or "Siamese" twinning. Skeleton A8597 has two heads, three arms, and two legs; A8613 has four arms, two legs, and two heads projecting from the ends of a joined vertebral column; A8572 is almost normal, but a tiny, headless brother with arms and legs projects from his chest. All are small and clearly died at birth or soon thereafter.

One skeleton stands out for its considerably larger size. A8599 is (or are)—and this is the issue we will soon discuss—twin girls with two well-formed heads and upper bodies with four full arms. Two distinct vertebral columns nearly join at their base, and only two well-formed legs extend below. The label reads *monstre humain dicéphale*, or "two-headed human monster." But A8599 was born live and survived several months. The twins were baptized and given names. The label records this poignant detail and includes, under the number and description, the identification "Ritta-Christina."

I mused much over Ritta and Christina, wondering about their life and death. Yet I would not have made the transition from troubled thought to column had I not discovered, quite by accident, a dusty old tome in a bookstore two days later—volume 11, for 1833, of the *Memoirs of the Royal Academy of Sciences*. It contained a long monograph by the great medical anatomist Etienne Serres: *Théorie des formations et des déformations organiques, appliquée à l'anatomie de Ritta Christina, et de la duplicité monstrueuse* ("Theory of organic development and deformation, applied to the anatomy of Ritta Christina, and to duplicate monsters in general").

Anyone who does not grasp the close juxtaposition of the vulgar and the scholarly has either too refined or too compartmentalized a view of life. Abstract and visceral fascination are equally valid and not so far apart. Two days before, I had seen young schoolchildren standing before Ritta-Christina in open-mouthed awe or horror, soon masked by forced humor. Now I learned that France's finest medical anatomist had dissected Ritta-Christina and used her to support a general theory of organic (not only human) embryology. Both themes seemed equally compelling to me; indeed, I had wallowed in both myself for two days. The children might not have generalized, but I have no doubt that M. Serres once gulped, as well as thought. I bought the book.

Ritta and Christina were born on March 23, 1829, to poor parents in Sardinia. Times were hard and social mobility scarcely possible in ordinary circumstances. Parents today would receive pity and experience only sorrow; in 1829, any realistic person, whatever his private feelings, must have recognized that such a child represented potential and substantial revenue, otherwise quite unobtainable. Thus, the parents of Ritta-Christina scraped together some funds and brought her to Paris, hoping to display her at fancy prices. The Hottentot Venus had provoked enough protest fifteen years earlier (see last month's column); but she was whole, however exotic. Public sensibilities had limits, and the authorities forbade any open display of Ritta and Christina. But she was shown privately, many times too often—for she died, in part from overexposure, after five months of life.

I have consciously switched back and forth from singular to plural in describing Ritta-Christina. When the vulgar and scholarly meet, a common question often underlies our joint fascination. One question has always overridden all others in this case—individuality. Was Ritta-Christina one person or two? This issue motivated the feeble jokes of my terrified

YOU COULD DRIVE ONE YEARS BEFORE UNLOADING IT.

Consider all the abuse a station wagon gets in its lifetime.

The endless shuttling from school to little league to piano lessons to home. The backseat battles that go on between the kids. The long hikes to weekend campsites. And all that hauling. Groceries, paneling, furniture, bicycles, lawnmowers.

People do things to a station wagon they would never do to a car.

And yet, Volvos in general have a life expectancy one third longer than the average of all other cars on the road.*

Volvo offers a full family of wagons to choose from. From turbocharged sports models to Diesels to our finely appointed GL Wagon.

All of them deliver something far more important these days than the capacity to carry things.

The capacity to carry on.

VOLVO
A car you can believe in.

*Analysis conducted by Ken Warwick & Associates, Inc. Based on a comparison of U.S. registration data for all Volvos and for the automobile industry as a whole and not by individual make or models. Data includes all models and not just station wagons. © 1982 Volvo of America Corporation. Roof rack optional.

schoolchildren. It also served as a focus for Serres's scientific investigation. And it underlay public fascination in 1829. When she died, a Parisian newspaper wrote: "Already it is a matter of grave consideration with the spiritualists, whether they had two souls or one."

One or two? Through all scholarly excursions and sideshow huckstering, this single question has been the focus of our fascination since Siamese twinning received its name. The originals, Eng and Chang, were born of Chinese parents in a small village near Bangkok in 1811 (Thailand was then called Siam). During the late 1820s and 1830s, they exhibited themselves in Europe and America and became quite wealthy. They decided to live in North Carolina where, at age 44, they married two sisters of English birth and settled down in two neighboring households to a comfortable life as successful (and, yes, even slaveholding) farmers. They switched houses at three-day intervals, traveling the one and a half mile distance by carriage. By the customs of the day, Chang was unquestioned master in his domicile, while Eng gave the orders *chez lui*. The unions were undeniably productive, for Chang had 10 children and Eng 12.

Chang and Eng were physically complete human beings connected by a thin band of tissue, three and a quarter inches at its widest and only one and five-eighths inches at its thickest. Each had a full set of parts down to the last toenail. They carried on independent conversations with visitors and had distinct personalities. Chang tended to be moody and melancholy and finally took to drink; Eng was quiet, contemplative, and more cheerful. Yet even they, history's most independent Siamese twins, apparently harbored private doubts about their individuality. They signed all legal documents "Chang Eng" and often spoke about their ambiguous feelings of autonomy.

But what of Ritta and Christina, whose bodily independence did not extend below the navel? They seemed, at first glance, to be two people above and but one below. One might have taken the easy way out and opted for the old cultural criterion of head and brain—two heads, two people. But as a scientist, Serres could not accept this solution, for he had also studied Siamese twins with one head, two arms, and four legs. He reasoned that a uniformity of process must underlie both types of twinning and could not accept the facile and simplistic resolution—one person if zipped halfway but starting from the top; two if zipped from the bottom.

Serres struggled with this momentous issue for 300 pages and finally concluded that Ritta *and* Christina were two people. His arguments and basic style of science belong to another era in the history of biology. They are worth recounting if only because few intellectual exercises are more rewarding than an examination of how radically different systems of thought treat a common subject of mutual interest. I also believe that Serres was at least half wrong.

Serres embodied the great early nineteenth-century tradition of romantic biology, called *Naturphilosophie* ("nature philosophy") in Germany and transcendental morphology in his native France. If modern morphologists study form either to determine evolutionary relationships and reconstruct the tree of life or to discover adaptive significance by examining function and behavior, Serres and his colleagues had markedly different goals. They were obsessed with the idea that some overarching, transcendental law must underlie and regulate all the apparent diversity of life.

These laws, in the Platonic tradition, must exist before any organism arises to obey their regularities. Organisms are accidental incarnations of the moment; the simple, regulating laws reflect timeless principles of universal order. Biology, as its primary task, must search for underlying patterns amidst the apparently confusing diversity of life. It must seek, in short, the "laws of form."

Serres followed his mentor, the great biologist Etienne Geoffroy Saint-Hilaire, in arguing that all animals share a common plan of construction, based on the vertebra as a building block. Linked vertebrae make a segmented animal; our skulls are the coalesced product of four primordial vertebrae. Insects and mammals share the same universal motif. Our soft parts are arranged around our vertebral axis. Insects have a segmented external skeleton; therefore, they dwell *within* their own vertebrae. (We now recognize that the segmentation of arthropods and vertebrates represents separate evolutionary events, and that no overarching law of form need underlie a superficial similarity.)

Original Siamese twins Chang and Eng

The Granger Collection

Serres made his most important contribution to the transcendental tradition in embryology. His colleagues had concentrated upon static adult form, searching for underlying patterns in final products alone. But organisms grow their own complexity from egg to adult. If laws of form regulate morphology, then we must discover principles for dynamic construction, not merely for relationships among finished creatures.

Serres's monograph on Ritta-Christina begins with an abstruse 200-page dissertation on the principles of morphology and their application to embryology. Unless we sneak a peek at the alluring plates in the back, we hear nothing of the famous Sardinian twins until our senses are numbed by generality. This organization, in itself, reflects a style of science strikingly different from our own. We maintain an empirical perspective and like to argue that generalities arise from the careful study and collation of particulars. Any modern embryologist would discuss Ritta-Christina first and only venture some short and cautious conclusions at the end. But Serres, as a transcendentalist, believed that laws of form existed before the animals that obeyed them. If abstraction preceded actuality in nature, why not in human creativity as well? Thought and theory first, application later. (Neither extreme well represents the intricate interplay of fact and theory in our actual practice of science, a theme of so many columns. Still, I suspect that Serres's "inverted" order is no worse a distortion of complex reality than our modern stylistic preferences.)

In the first pages of his monograph, Serres tries to reduce the embryology of all animals to three basic laws of "organology." First, by the law of *eccentric development*, otherwise known as the law of circumference to center, organs form initially at the edge of the developing embryo and then migrate toward the center. Second, by the law of *symmetry*, organs that become single and central in adults begin as double symmetrical rudiments on opposite edges of the developing embryo. Third, by the law of *affinity*, these symmetrical rudiments are drawn to each other until they fuse in the center to form a single adult organ. (Let me be charitable and simply

Three by Gould

And a special offer for members of the American Museum of Natural History

Stephen Jay Gould has been acclaimed as one of the world's leading biologists and natural history writers. He is best known to readers of NATURAL HISTORY for his delightful and brilliant column, *This View of Life*.

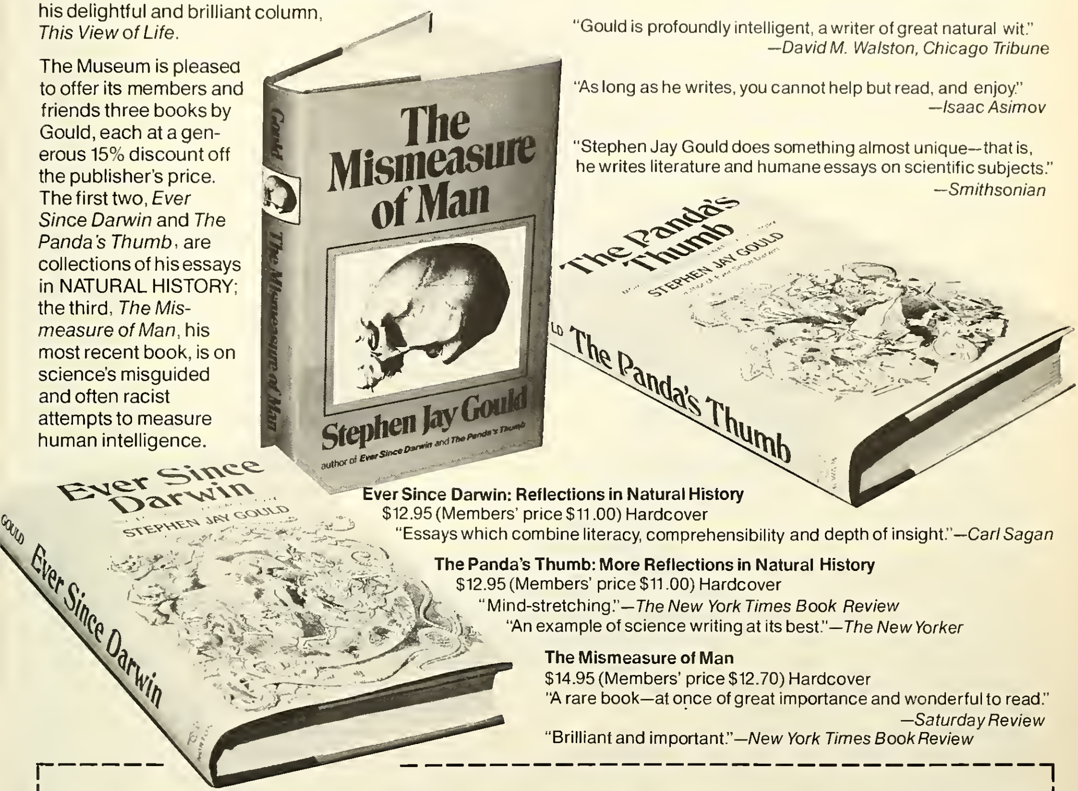
The Museum is pleased to offer its members and friends three books by Gould, each at a generous 15% discount off the publisher's price. The first two, *Ever Since Darwin* and *The Panda's Thumb*, are collections of his essays in NATURAL HISTORY; the third, *The Mismeasure of Man*, his most recent book, is on science's misguided and often racist attempts to measure human intelligence.

"Stephen Jay Gould is one of the most brilliant of our younger scientists, gifted, among other things, with the ability to write."
—*Ashley Montagu*

"Gould is profoundly intelligent, a writer of great natural wit."
—*David M. Walston, Chicago Tribune*

"As long as he writes, you cannot help but read, and enjoy."
—*Isaac Asimov*

"Stephen Jay Gould does something almost unique—that is, he writes literature and humane essays on scientific subjects."
—*Smithsonian*



Ever Since Darwin: Reflections in Natural History
$12.95 (Members' price $11.00) Hardcover
"Essays which combine literacy, comprehensibility and depth of insight."—*Carl Sagan*

The Panda's Thumb: More Reflections in Natural History
$12.95 (Members' price $11.00) Hardcover
"Mind-stretching."—*The New York Times Book Review*
"An example of science writing at its best."—*The New Yorker*

The Mismeasure of Man
$14.95 (Members' price $12.70) Hardcover
"A rare book—at once of great importance and wonderful to read."
—*Saturday Review*
"Brilliant and important."—*New York Times Book Review*

Send to: **Members' Book Program** American Museum of Natural History, Central Park West at 79th Street, New York, NY 10024

Name:______________________________
Address:______________________________
(Note: U.P.S. will not deliver to P.O. boxes)
City:____________State: ______ Zip: ______
Please charge my credit card account (circle one)
MASTERCARD VISA
Acct = ____________________________
(All numbers, please)
Exp. date:_______Signature:______________

I would like to order the following books:

Title	Qty	Price
Ever Since Darwin		
The Panda's Thumb		
The Mismeasure of Man		
Add $2.00 for U.P.S. delivery: FREE DELIVERY with order of all three		$2.00
Total Enclosed:		

Please make checks payable to the American Museum of Natural History. Order by December 1, 1982 to assure Christmas delivery.

To obtain these special discounts at the Museum Shop, please present this coupon with your membership card.
Special discounts apply in lieu of regular members' discounts.

state that these laws are unwarranted extensions of patterns that operate occasionally in development. Serres was writing before the establishment of cell theory and just a few years after Karl Ernst von Baer's discovery of the human ovum. His formal approach to morphology, so foreign to a world that can assess cellular and even molecular causes, fit the knowledge and mores of his own era.)

Two hundred pages later, when Serres finally discusses his dissection of Ritta-Christina, we understand why he devoted so much preceding space to the three great laws of organology—for they provide his solution to the great dilemma of individuality. Ritta and Christina are two people, albeit imperfect, and the laws of form proclaim *their* status.

No one quarreled with the double verdict on Ritta and Christina from the waist up; the dilemma had always rested upon their well-formed, but clearly single, lower half—one anus, one vaginal opening, two legs. If she were two people all the way from stem to stern, how could her lower half form so well in the shape of one? How could the incomplete parts of two separate creatures fuse and blend into a form indistinguishable from the lower half of such unambiguous singletons as you or me?

Serres used his laws of organology to render Ritta and Christina's lower half as the conjoined product of two people. After all, the harmonious, well-formed single organs of ordinary individuals arise (by the law of symmetry) as separate and double parts at the embryo's edge, and then move inward (by the law of circumference to center), eventually meeting and fusing (by the law of affinity) into one integral organ. If our single heart, stomach, and liver begin as two symmetrical rudiments, then why should we view the presence of a single, well-formed organ in Ritta and Christina's lower half as any argument against its construction from the mingled and melded parts of two embryonic individuals? If the twins have but one uterus, then the right half came from Ritta, the left from Christina. The two rudiments formed at the embryonic edges, in regions unambiguously assigned to Ritta or to Christina (law of symmetry). They moved toward the midline (circumference to center) and joined there (law of affinity) to form a single organ.

Serres announced proudly that his laws of form had resolved the great dilemma in favor of duality: "How could we possibly have conceived that each child furnished half of an organ common to both, if the law of eccentric development had not taught us that single organs are, in their normal state, originally double."

Nor did Serres shrink from the decidedly peculiar logical implications of his solution. He noted that the large uterus had proper connections with the ovaries and vaginal canal and saw no reason why Ritta and Christina might not have borne children had they lived to maturity. (Serres also found a second, rudimentary uterus that would not have worked.) He concluded that the large uterus had formed half from Ritta and half from Christina, and admitted that any children would have two natural mothers:

> This disposition of Ritta and Christina's genital organs evidently shows . . . that while nature had taken measures to assure the lives of these children, she had not forgotten the possibility of their reproduction. Now, for this reproduction, nature had combined everything, so that all the pleasures and pains would be shared. . . . Supposing that conception occurred in the large uterus, a single child would have had two distinct mothers, a singular result of this associated life.

Serres then discussed a pair of conjoined males with four legs and a single head, and opted for consistency and duality: the single well-formed brain shared the combined thoughts of two.

> There is a perfect unity produced by two distinct individualities. There are sense organs and cerebral hemispheres for a single individual, adapted to the service of two, since it is evident that there are two *me*'s in this single head [*deux* moi *dans cette tête unique*].

Thus Serres made a valiant and consistent attempt to resolve a question that seemed hopelessly ambiguous. We may appreciate the effort and enjoy an excursion into the different view of biology that supported it. But we must reject the conclusion.

Fertilized human eggs usually develop into single individuals. Rarely, the dividing cells separate into discrete groups, and two embryos develop. These one-egg (or identical) twins are genetic carbon copies. In some ultimate, biological sense, they are the same iterated individual—and the psychological literature contains ample testimony to feelings of imperfect separation shared by many so-called identical twins. Yet, at least for definition's sake, we have no difficulty in identifying one-egg human twins as undeniably separate personalities for two excellent reasons: first, physical separation is the essence of our vernacular definition of individuality; second, human personalities are so subtly and pervasively shaped by complex environments of life (whatever the quirky similarities between one-egg twins reared apart) that each person follows a unique path.

With vastly greater rarity, the dividing cells of a fertilized egg begin to separate into two groups, but do not complete the process—and conjoined (or Siamese) twins develop. Conjoined twins span the entire conceivable range from a single individual bearing a few rudimentary parts of an imperfect twin, to superficially joined, complete individuals like Chang and Eng. Ritta and Christina fall squarely in the middle of this continuum. With our modern knowledge of their biological formation, I fear that we must reject Serres's solution, and admit instead that his dilemma cannot be answered.

We live in a complex world. Some boundaries are sharp and permit clean, either/or definitions. But nature is replete with continua that cannot be nicely parceled into two piles of unambiguous yeses and noes. Biologists have heaped almost universal scorn upon attempts by anti-abortionists to define an unambiguous "beginning of life," because we know so well that the sequence from ovulation or spermatogenesis to birth is an unbreakable continuum—and surely no one will define masturbation as murder. Our congressmen may create a legal fiction for statutory effect but they may not seek support from biology. Ritta and Christina lay in the middle of another unbreakable continuum. They are in part two and in part one. And that, I am sorry to say, is the biological nonanswer to the question of the centuries.

If this claim leaves you with an empty feeling after so much verbiage, I can only contend that the most liberating response to an old mystery is often, The question has no answer because you asked the wrong question. The old question of individuality is rooted in the assumption that events can be pigeonholed into discrete categories. If we recognize that our world is full of irreducible continua, we will not be troubled by the intermediate status of Ritta and Christina.

Dante punished schismatics by dismembering them in hell to exact a physical punishment worthy of their ideological crime: "Lo, how is Mohammed mangled. . . . Whom here thou seest, while they lived, did sow scandal and schism, and therefore thus are rent."

Let us value connections. As Dante analogized physical with ideological separation, perhaps we can learn from the indissoluble union of Ritta and Christina that our intellectual world has its continuity as well.

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

NE

"The Rattlesnake"

by Frederic Remington

- Available in a single limited edition issue of 9500 serially numbered sculptures.
- An outstanding museum quality reproduction in the great tradition of Frederic Remington.

Shown smaller than actual size of 8½" high.

One of Frederic Remington's best known and dramatic works — "The Rattlesnake" depicts in vivid detail the classic moment as horse and rider encounter a startled snake, while on the trail. The few original bronzes, made by Remington in 1905, are rare and have sold at auction for over $135,000. Now this ⅓ size reproduction is available for the unusual offering price of only $195.00 per sculpture.

The fine reproduction was produced under the direct supervision of Ms. Christine Roussel — former Director of the Reproduction Studio of the Metropolitan Museum of Art and creator of fine Remington reproductions for The Nelson Rockefeller Collection.

Each Rattlesnake replica will be created in cold-cast bronze — a medium that enables the casting of finer detail than the traditional hot-cast method. Every sculpture will be individually cast from a blend of powdered bronze and resins. Once the casting is completed, it will be finished with a rich patina, similar to the original. Each Remington Rattlesnake will be serially numbered and hallmarked. The edition will be limited to 9500 pieces and after that, all molds will be destroyed forever.

To reserve this important Remington reproduction, simply return the application. No payment need accompany your order at this time.

"The Rattlesnake"

Limit: one per person

New England Collectors Society, Dept. FR-21
62 Eastview Ave.
Pleasantville, N.Y. 10570

Please accept my reservation for "The Rattlesnake", to be crafted for me in cold-cast bronze at $195.00* plus $3.00 for shipping and handling.

I understand I need send no money now. When my sculpture is ready for shipment, I will be billed for my deposit of $49.50* and, after shipment, for the balance in three monthly installments of $49.50* each.

I would like my four equal payments of $49.50* charged to my:

☐ Master Card ☐ VISA

Or call Toll Free: 1-800-228-2028 ext. 560

Credit Card # ____________________

Exp. Date ____________________

Signature ____________________

all applications are subject to acceptance

Name ____________________

Address ____________________

City ____________________

State ____________ Zip ____________

*N.Y. residents add 5% for sales tax.

The Cold Facts of Winter Wheat

Some varieties of wheat survive the winter because their membranes don't get stiff in the cold

by Robert E. Cook

Winter in Kansas can be very cold. In most years, the ground is frozen beneath a coat of snow from November to March, and air temperatures frequently slip well below zero. Such a harsh winter would hardly seem the ideal growing season for a major food crop, yet more than half the wheat eaten in the United States is sown in September and harvested the following summer. Winter varieties are planted throughout the south-central Great Plains. Farther north, in the Dakotas and southern Canada, winters are so severe that only spring wheats, which are planted in April and mature in the fall, can be grown. By gaining a head start before the first snows, fields of winter wheat consistently outyield spring varieties.

The survival of wheat seedlings in such a growing regime requires a remarkable hardiness: the shoots must endure cycles of freezing and thawing, frost heaving, slow desiccation, and intense compaction under the accumulating ice and snow. Planting grains in September permits the rapid establishment of an anchoring root system. This provides the young plant some protection against the winter turbulence of the soil. Buds in the axil of each basal leaf begin growing in October, initiating lateral shoots that form a dense rosette. During fall growth, the sections of stem between successive leaves remain very short, and the green seedlings are little more than a compact crown close to the surface of the ground.

Whether a field of seedlings survives the winter to become a harvestable crop depends largely on the young plants' tolerance to deep cold. Wheat seedlings of hardy varieties are not born with such a tolerance; they must acquire it before the first killing frost each fall. As the days grow shorter and the nights colder, each plant prepares for freezing. This acclimation process, known to agronomists as hardening, is critical to winter survival. For instance, if sufficiently acclimated, Kharkov red wheat, a winter variety commonly grown in central and western Kansas, can survive air temperatures as low as −20°F in open ground and as much as −40°F when covered by snow.

After the spring thaw, however, the hardened state is lost, and any drop in temperature below freezing will severely damage the shoot. Plant breeders, eager to expand the range of winter wheat farther north into regions where only spring wheats can currently be grown, have been studying the process of hardening in winter varieties. The search for the mechanisms that permit certain varieties to survive the stresses of freezing have led scientists to the most fundamental unit of tissue organization: the living cell.

Plants, by and large, are passive, rooted to the earth, incapable of behavior in the usual sense of the word. They respond to falling temperatures simply by slowing down cellular processes, which run about half as fast for each ten degree drop. The slowdown cannot continue indefinitely, however; if temperatures drop below the point at which a particular plant can continue functioning, injury will result. In many species of tropical plants, for example, some physiological processes stop altogether after prolonged periods of cold, even though temperatures may hover above freezing. For winter wheat and other plants capable of surviving temperatures below freezing, the real threat of deep cold comes from the water present in and around cells and the transformation of that water into ice. An explanation of winter wheat's tolerance to cold must begin with the normal role of water in the cell.

Each plant cell is encased in a wall of cellulose, embedding it in a rigid framework that gives stiffness to plant tissue and architectural form to the array of leaves and branches in space. The cell itself is like a flexible sac filled with a liquid bath, within which various tubes, bodies, and smaller sacs are suspended. These internal structures, called organelles, effectively compartmentalize different cellular functions such as photosynthesis and respiration. Surrounding this highly structured soup is a semipermeable membrane. Built like a sandwich, the membrane consists of an internal layer of lipids and fats, somewhat fluid in viscosity, sheeted on each side by a coat of protein. Small holes penetrate the membrane, and the traffic of nutrients, toxic waste products, and other substances through these pores is regulated by the particular constellation of surrounding lipids and proteins.

The membrane maintains appropriate internal concentrations of solutes by adjusting the movement of salts and sugars in and out of the sac. Water, which can move freely through the pores of the membrane, flows from areas with lower concentrations of solutes to areas of higher concentrations. This osmotic diffusion tends to equalize the concentration of substances on each side. Thus an influx of solutes will be followed by a flush of water, which expands the cell against its exterior walls and maintains the internal pressure characteristic of hydrated tissue.

Unlike water, ice does not flow freely across cell boundaries. For a plant, this difference can be fatal. A sudden frost in an early Kansas autumn, for example, may hit before the hardening process in

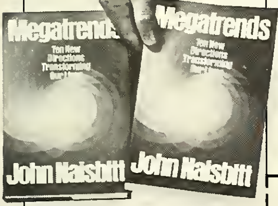
HOW TO BEAT TODAY'S HARDCOVER PRICES

You don't judge a book by its cover, so why pay for the cover?

QPB books are softcover editions in hardcover sizes, durably bound and printed on fine paper. But they cost up to 65% less than their hardcover counterparts.

Now you know how to beat today's prices: Join QPB.

Compare


Megatrends
Ten New Directions Transforming Our Lives
John Naisbitt
Megatrends
Ten New Directions Transforming Our Lives
John Naisbitt

Hardcover:	QPB Softcover:
$15.50	$7.95

507. **Megatrends.** John Naisbitt
Hardcover: $15.50 **QPB Ed: $7.95**

524. **Science Observed:** Essays Out of My Mind. Jeremy Bernstein
Hardcover: $16.95 **QPB Ed: $8.95**

483. **Nova:** Adventures in Science. WGBH Boston
Hardcover: $27.95 **QPB: $11.95**

614. **The Woodwright's Shop**
A Practical Guide to Traditional Woodcraft. Roy Underhill
Hardcover: $19.95 **QPB: $9.50**

632. **Dover Logic Books:** *Puzzles in Math and Logic,* Aaron J. Friedland; *My Best Puzzles in Logic and Reasoning,* Hubert Phillips ("Caliban"); *Test Your Logic,* George J. Summers; *Recreations in Logic,* D.G. Wells. (4 Vols.)
QPB: $7.50

659. **The Film Encyclopedia**
Ephraim Katz
Hardcover: $29.95 **QPB: $11.95**

671. **The Origin of Consciousness in the Breakdown of the Bicameral Mind.** Julian Jaynes
Hardcover: $16.95 **QPB: $7.95**

108. **Build Your Own Furniture**
Peter Stamberg. **QPB: $7.95**

465. **Taking the Quantum Leap**
The New Physics for Nonscientists. Fred Alan Wolf. **QPB: $7.95**

473. **Space, Time & Medicine**
Larry Dossey, M.D.
Foreword by Fritjof Capra
Hardcover: $15.95 **QPB: $7.95**

672

672. **Unfinished Tales of Númenor and Middle-earth**
J. R. R. Tolkien
Hardcover: $15 **QPB: $6.95**

673. **Ernest Hemingway**
Selected Letters, 1917-1961. Edited by Carlos Baker
Hardcover: $27.50 **QPB: $10.95**

286. **A Book of Five Rings**
Miyamoto Musashi
Translated by Victor Harris
Hardcover: $12.95 **QPB: $4.95**

308. **Economics Explained.** Robert L. Heilbroner and Lester C. Thurow
Hardcover: $12.95 **QPB Ed: $6.95**

447. **Myths of Greece and Rome**
Thomas Bulfinch. Compiled by Bryan Holme. **QPB: $8.95**

351

351. **The American Medical Association's Handbook of First Aid and Emergency Care**
Developed by the American Medical Association. **QPB: $4.95**

392. **The Nine Nations of North America.** Joel Garreau
Hardcover: $14.95 **QPB: $6.50**

398. **The Dinosaurs.** Illustrated by William Stout, Edited by Byron Preiss, Introduction by Dr. Peter Dodson
QPB: $10.95

401. **The Mapmakers.** John Noble Wilford. Hardcover: $20 **QPB: $7.95**

424. **The Electronic Cottage**
Everyday Living with Your Personal Computers in the 1980s. Joseph Deken
Hardcover: $14.95 **QPB Ed: $7.50**

Let's give each other a try.

Quality Paperback Book Club, Inc., Middletown, Pa. 17057. Please enroll me in QPB and send the 3 choices I've listed below. Bill me $3, plus shipping and handling charges. I understand that I am not required to buy another book. You will send me the QPB *Review* as long as my account is in good standing, but I understand that if I don't buy at least 1 book a year you may cancel my membership. A shipping and handling charge is added to each shipment. QB113-11X

Indicate by number the 3 books or sets you want ☐ ☐ ☐

Name______________________________ 2-16
(Please print clearly)

Address____________________ **Apt.**______

City____________ **State**______ **Zip**______

How membership works.
1. You receive **QPB Review** 15 times each year (about every 3½ weeks). Each issue reviews a new **Selection,** plus scores of Alternates.
2. If you want the **Selection** do nothing. It will be shipped to you automatically. If you want one or more Alternate books—or no book at all—indicate your decision on the Reply Form always enclosed and return it by the date specified.
3. **Bonus books for Bonus Points.** For each QPB book or set you take (except for the books in this offer), you earn Bonus Points which entitle you to choose any of our softcover books. You pay only shipping and handling charges.
4. **Return privilege.** If *QPB Review* is delayed and you receive the **Selection** without having had 10 days to notify us, you may return it for credit at our expense.
5. **Cancellations.** You may cancel membership at any time by notifying QPB. We may cancel your membership if you elect not to buy and pay for at least one book a year.

Prices generally higher in Canada.

111. **The Search for Alexander**
An Exhibition. Contributions by Nicholas Yalouris, Manolis Andronikos, and Katerina Rhomiopoulou. (Photographs)
Hardcover: $24.95 **QPB: $9.95**

124. **A Field Guide to American Architecture.** Carole Rifkind
Hardcover: $19.95 **QPB: $7.95**

151. **The Lord of the Rings**
(3 Vols., Boxed) J. R. R. Tolkien
Hardcover: $35.95 **QPB: $9.95**

222. **The Mismeasure of Man and The Panda's Thumb** (2 Vols., Boxed) Stephen Jay Gould
Hardcover: $27.90 **QPB Ed: $11.95**

283. **The Structures of Everyday Life.** Fernand Braudel
Hardcover: $30 **QPB Ed: $12.95**

427. **Other Worlds:** A Portrait of Nature in Rebellion; Space, Superspace and the Quantum Universe. Paul Davies
Hardcover: $11.95 **QPB: $4.25**

Join now. Pick any 3 books or sets for $1 each—with no obligation to buy another book.

596. **The Solar Age Resource Book**
Editors of 'Solar Age' magazine
QPB: $7.95

267. **The Timetables of History**
Bernard Grun
Hardcover: $29.95 **QPB: $11.95**

444. **Dictionary of Philosophy and Religion:** Eastern and Western Thought. William L. Reese
Hardcover: $29.95 **QPB: $10.95**

182. **Ah, But Your Land Is Beautiful**
Alan Paton
Hardcover: $12.95 **QPB Ed: $6.95**

414. **The Life and Times of Joe McCarthy.** Thomas C. Reeves
Hardcover: $19.95 **QPB Ed: $9.95**

421. **Life on Earth:** A Natural History. David Attenborough
Hardcover: $22.50 **QPB Ed: $9.95**

574. **The Foundation Trilogy**
(3 Vols.) Isaac Asimov
QPB: $6.95

519. **Modern Art:** 19th and 20th Centuries. Meyer Schapiro
Hardcover: $20 **QPB: $9.95**

594. **Dover Math Books:** *Challenging Mathematical Teasers, Fun With Figures, Mathematical Brain-Teasers,* J. A. H. Hunter; *Mathematical Diversions,* J. A. H. Hunter and Joseph S. Madachy. (4 Vols.)
QPB: $9.75

163. **Conceptual Blockbusting**
A Guide to Better Ideas (Second Edition). James L. Adams
Hardcover: $10.95 **QPB: $3.95**

QPB®

The first book club for smart people who aren't rich.

Woodcut by Carla Bauer

wheat seedlings is complete. Such frosts often occur on clear, cloudless nights; if the season has not yet produced a cover of snow, each small shoot of wheat will radiate the heat it accumulated during the day to the cold night air. With no exterior protection, the plant is little more than a collection of water-filled cells, each of which must individually tolerate these freezing conditions or succumb.

As the temperature of a cell in an unacclimated plant drops, the liquid layer of fat between the protein sheathing begins to thicken, stiffening the membrane. The first ice forms from the relatively pure water that lies outside the cell in niches between cellulose walls. As these crystals grow, water is slowly sucked out of the cell, dehydrating the internal organelles and concentrating the contents to toxic proportions. The cell volume shrinks, compressing the contents and severely distorting the surrounding membrane, which begins to collapse away from the cell wall. If the membrane's lipid layers have stiffened, the quick distortion of its shape may rip its surface in two. When cell temperatures fall very fast, the expanding crystals of ice outside the cell can traverse the pores and invade the cytoplasm, rupturing the surface and cutting up internal organelles. This formation of intracellular ice is always lethal to the cell.

Once frozen, the shoot remains stiff until a thaw. Then, as the damaged tissues melt, cellular fluids flow through the ruptured membrane into the extracellular spaces. Critical concentrations of substances can no longer be regulated, the capacity to control internal pressure is lost, and the cells break into fragments. The shoot, as limp as wilted lettuce, collapses to the ground.

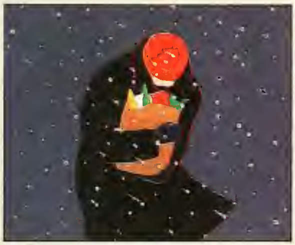
Varieties of wheat that can survive the stresses of a Kansas winter depend upon several lines of defense. Long before the first freeze, the approach of winter is signaled by cooler nights and the declining length of daylight. In response to these signals, the seedlings undergo a sequence of developmental changes, regulated by shifts in the balance of critical hormones that prepare the plants for dormancy. Roots absorb less moisture and the water content of critical tissues gradually drops. The production of new leaves ceases for the winter.

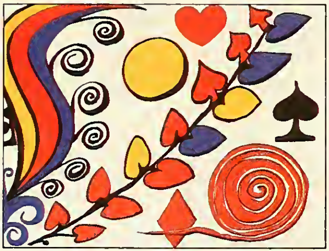
At the level of the cell, a series of transformations prepares the membrane for cold and ice. The fats in the lipid layer, which have functioned well at high temperatures, are replaced by unsaturated forms, which remain liquid at lower temperatures. Much as a change of oil can help an automobile engine run smoothly in winter, this substitution of fats permits more flexible functioning of the membrane in cold weather. In addition, stores of insoluble starch that were built up early in the seedling's growth are converted to soluble sugars, increasing the concentration of solutes in the cell sap. The higher concentration effectively lowers the freezing point about five degrees, affording the interior of the cell some protection. Thus, ice forms externally, in the purer water surrounding the cell wall, and water begins to flow out of the cell to feed these growing crystals. The prevention of internal ice depends upon this outward flow of water and on the continued functioning of the sheathing membrane at near freezing temperatures.

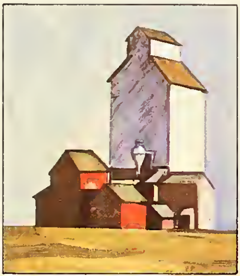
Keeping ice out of the cells is not enough, however. With the loss of water, the cells also confront problems associated with severe dehydration: the rising concentration of toxic substances, such as salts, and a drastic decrease in the volume of the cell. Unlike unacclimated cells, hardened cells manage to survive this compression. Although uncertain of the mechanism, plant physiologists have focused on alterations that occur in the architecture of the membrane itself during acclimation.

Cell membranes are extremely thin and hidden in a matrix of cellulose. Watching the membranes as they compress under the stresses of freezing requires freeing the individual cells and their membranes from the surrounding cell walls. To do this, biologists prepare a roughly cut salad of plant tissue, tossed with a dressing of enzymes that digest the cellulose and release the cell contents. The resultant slush is poured through a fine mesh filter to yield what are called protoplasts—living sacs of cytoplasm surrounded by an intact membrane free from the cell walls. This colony of cells is then maintained in a cul-

True or False?


Thom De Jong's *Shopping in the Snow*, original etching. Signed limited edition of 150.


Alexander Calder's *Les Fleurs*, original lithograph. Signed limited edition of 90.


Carol Wald's *Sentinel of the Plains*, original lithograph. Signed limited edition of 250.

( ) Original art costs big money—especially limited editions.
( ) You take a risk on authenticity and investment value.
( ) You can't return what you don't like.

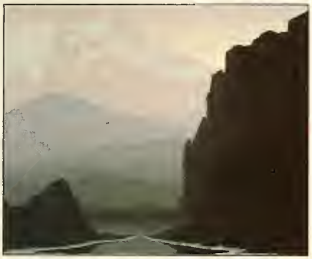
If you answered *False* to all the questions, you know the truth about buying art from the Original Print Collectors Group.

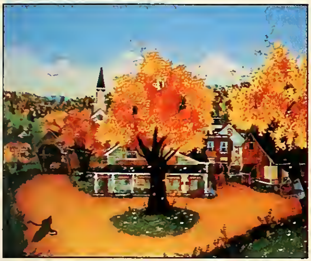
We offer you signed original work by Calder. Chagall. Miró. Picasso. Vasarely. And other important artists represented in the world's great museums and galleries.

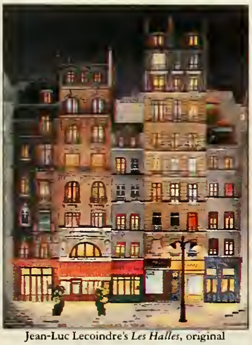
You can choose limited edition etchings, engravings, lithographs, woodcuts, and silk-screen prints, signed and numbered by the artists themselves. And prices start as low as $200.

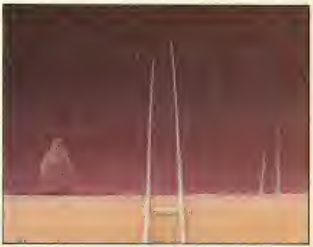
We select prints for value as well as beauty. Every print comes with a Certificate of Authenticity, your assurance that you own a bona fide, signed, limited edition original. And you also get a full money-back guarantee.

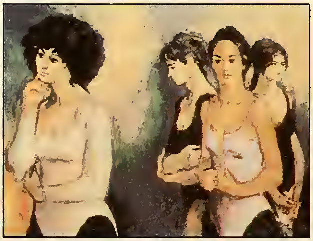
For more information, without obligation, send in the coupon today. We'll send you a beautiful color catalog—free. Get the right facts about the rewards of owning original art.

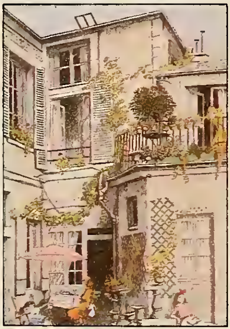

Jerome Schurr's *Mt. McKinley*, original serigraph. Signed limited edition of 290.


Robert Logrippo's *Circus is Coming to Town*, original lithograph. Signed limited edition of 250.


Jean-Luc Lecoindre's *Les Halles*, original lithograph. Signed limited edition of 175.


John Axton's *Acoma Skies*, original lithograph. Signed limited edition of 150.


Jan De Ruth's *In the Wings*, original serigraph. Signed limited edition of 250.


Denis-Paul Noyer's *Les Vacances*, original lithograph. Signed limited edition of 300.

Visit our new gallery located at 215 Lexington Avenue,
Mon–Fri, 9–5 PM. Telephone: 212-685-9400 Ext: 35

Original print collectors group, Ltd.
215 LEXINGTON AVE., DEPT. NH-47, NEW YORK 10016

PLEASE SEND ME YOUR FREE COLOR CATALOGUE WITHOUT OBLIGATION.

NAME ____________________
(PLEASE PRINT)
ADDRESS ____________________
CITY ____________ ST ______ ZIP ______

© 1982 OPCG, LTD

LUNATION
. . . the period required for one complete cycle of the moon's phases. Now you can illustrate this fascinating progression with the acclaimed

LUNAR PHASE POSTER

This 40 x 93 cm color chart shows the correct phase of the moon for every day of the year. Created by an astronomer with you in mind—don't be without one.

Rolled in a tube. Order LPP83. $6.00 ppd.

VISA CELESTIAL PRODUCTS Inc MC
10 W. WASHINGTON ST.
MIDDLEBURG, VA 22117
703-687-6881

In 1974 we originated our epoch-making ***Galapagos Islands Thrift Cruises,*** *which for several years enabled many hundreds of budget-minded travelers who were interested in ecology, wildlife and photography to see these unique islands without luxurious trimmings but under expert guidance*

Since last year, we offer a budget program including some of the highlights which make a visit to this remarkable archipelago such a renowned tourist attraction. We explore five of the islands in order to view sea lions, iguanas and a large variety of birds, such as the famous Darwin's finches, boobies, frigates and gulls

Galapagos Islands Thrift Program®

MARCH 31 TO APRIL 10, 1983
JUNE 30 TO JULY 10, 1983
AUGUST 11 TO 21, 1983
DECEMBER 31, 1983 TO JANUARY 8, 1984

Our program includes easy hikes on Santa Cruz to see tortoises roaming free and to the top of the dormant volcano at Sullivan Bay, and ample opportunities for swimming and snorkeling. It is ideal for young people and families with children and has been planned during periods of school and college vacations.

We do not claim that these programs are as comprehensive as our superb and unrivalled **Discover Galapagos** yacht cruises in January, May and August, 1983; but our meticulously supervised arrangements do provide you with a fascinating introduction to these wonderful islands—and at a third of the cost.

Each program is accompanied by one of our expert leaders and a naturalist guide who give informative talks and lead us in the field.

Before the week at the islands, we spend two days at the best hotel in Quito, Ecuador's lovely capital in the Andes

Please send for the detailed brochure of these programs — we also specialize in expeditions to Greenland, Mount Kilimanjaro, the Himalayas and the Andes; wildlife safaris to see polar bears in northern Canada and to Scotland, Borneo and Rajasthan; and archeological tours to Peru and Egypt

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

ture medium containing some sugars, mineral nutrients, and small concentrations of plant hormones.

Using this technique at Cornell University, Peter Steponkus has been watching the membranes of protoplasts from varieties of winter rye—another important cereal capable of acclimating to severe cold. To observe the process of freezing, Steponkus mounts his population of cultured cells on a cryomicroscope. This scope is electronically equipped to lower the temperature of any tissue under observation at rates of up to eight degrees per second. By attaching a photomicrographic video system to the scope, he can record the process of freezing and follow the invasion of ice as it traverses the membrane.

Steponkus first verified the destructive impact of ice on unacclimated protoplasts. As the temperature dropped below zero, the anticipated flow of cellular solution out through the membrane occurred. Suddenly he observed a fluttering at the membrane's surface followed by an eddy of cytoplasm in the vicinity. Instantly, ice slipped through the membrane and solidified the cell contents. The integrity of the membrane had apparently snapped, allowing the ice to penetrate.

To explain this behavior, Steponkus hypothesized an upper threshold to the amount of deformation a contracting membrane can survive without rupture. Below a certain size limit, lesions form and the cell disintegrates. Acclimation somehow lowers the critical size and permits the cell to reexpand successfully even though its volume has been severely reduced.

Unfortunately Steponkus found that the details of membrane constriction were somewhat obscured by the surrounding shell of ice. In order to obtain a better view of the contracting membranes, he took advantage of the similar effect that freezing and drought have on cells: both cause dehydration. Furthermore, acclimation to inadequate water can also prepare a plant to survive deep cold. Wheat and rye seedlings, for example, will acquire tolerance to freezing if they are subjected to a period of desiccation for several weeks at room temperatures. Therefore Steponkus was able to simulate the effects of extracellular ice formation by immersing his cultured protoplasts in saline solutions. The higher concentration of salts outside the cells drew water out, compressing the volume of the protoplast. By adjusting the salinity of the external medium, he achieved different degrees of membrane deformation.

Unhardened protoplasts shrink rapidly when placed into saline solution. As the volume grows smaller, the outer surface of the membrane remains smooth. Inside the cell, however, numerous droplets begin to emerge and float free among the inclusions of the cytoplasm. Apparently, under the compression caused by membrane shrinkage, fragments of membrane lipids are squeezed like grease out of the surrounding sheath. When the saline solution is diluted, the cell reexpands, lesions appear in the membrane surface, and the cell suddenly splits, releasing the fluids within.

Protoplasts from acclimated tissues behave very differently. As the cells compress, changes in the membrane first appear in the form of small folds and pleats. Gradually, many little tethered spheres and filaments of extruded material rise out of the membrane's external surface, forming small pockets and reservoirs. When the protoplasts begin inflating with water again, the loops of extruded material are gradually meshed back into the matrix of the membrane, restoring it to its former size without lesions. Other researchers have observed similar phenomena in hardy varieties of winter wheat. They suggest that during contraction only specific fractions of the membrane's lipids are stored externally. These conserved lipids are rapidly reincorporated during expansion. Acclimation bestows on the cell an ability to shrivel to half its former size while preserving the integrity of its surrounding membrane and the potential for successful reexpansion.

Thus the survival of wheat in a Kansas winter finally comes down to the scale of tiny membranes and their flexibility within the cell. This knowledge may not provide much immediate help to farmers of more northerly latitudes. Nor may it be of much direct use to the Kansas farmer who, faced with the unpredictability of snow and cold, must determine the appropriate time for planting and hope for the survival of his crop until the harvest. But the advantages of a growing season that starts in September greatly outweigh the risks since with the first warm days of spring, the crown of a wheat seedling that has survived the winter will be larger and far more vigorous than the growing tip of a seedling that is just germinating. If the farmers of the north are to someday share the benefits of hardy winter wheats, the harvests they reap may be, in part, the result of knowledge gained at the smallest of scales.

Robert E. Cook is program director of the National Science Foundation's Population Biology and Physiological Ecology Program.

GIVE NATURAL HISTORY

This Holiday Season give one gift at $15
and save 20% on subsequent gifts at $12 each

☐ YES, send ______ gifts, which include 12 thought-provoking issues of Natural History and all the benefits of a one-year Associate Membership in the American Museum of Natural History.

GIFT TO:

Name ____________________
Address ____________________
City ____________________
State ____________ Zip ____________

GIFT TO:

Name ____________________
Address ____________________
City ____________________
State ____________ Zip ____________

Mail this Postage-paid card Today!

GIFT FROM: J565

Name ____________________
Address ____________________
City ____________________
State ____________ Zip ____________

☐ Payment enclosed ☐ Bill me
Charge my ☐ Visa ☐ Mastercharge
☐ American Express

Account number
☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Signature ____________________

☐ 1 Gift at $15 $15
☐ Additional Gifts at $12 ______
(20% savings)
Total Enclosed $ ______

Outside U.S.A. please add $5 for postage

Moneyback guarantee if not satisfied

Special Money Saving Gift offer!

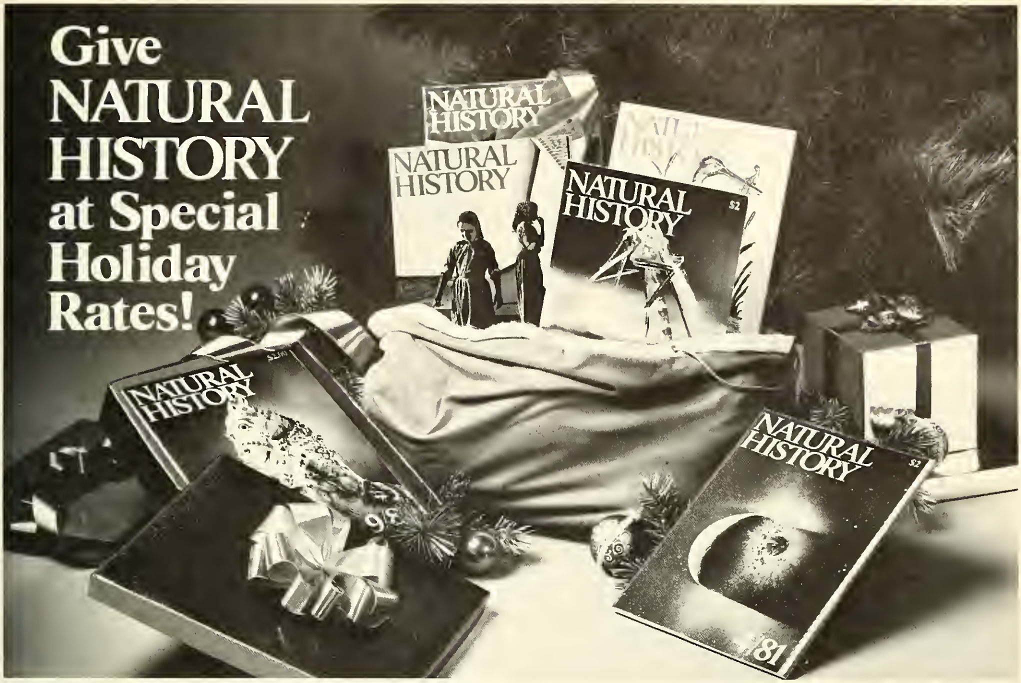
NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO 30 BERGENFIELD, N J

POSTAGE WILL BE PAID BY ADDRESSEE

NATURAL HISTORY
P.O. Box 4200
Bergenfield, N.J. 07621



This holiday season give the **distinctive gift** that is inexpensive and easy to give. **Natural History** is the perfect holiday gift that keeps giving all year long.

It's inexpensive—only $15 for your first gift
It saves you money—only $12 for each additional gift
It's easy—Use the postage paid cards in the magazine or call the toll-free number listed below.

Your gift recipient(s) will receive a valuable membership card that entitles him or her to all the benefits listed on the right. You'll be able to announce each gift with an attractive gift card we will send you as soon as we receive your order.

Give the gift of Natural History and membership in the American Museum today!

Your Gift brings all these Benefits:

- A one year subscription to Natural History (12 issues)
- Free admission to the American Museum of Natural History
- Access to the air-conditioned Members' Lounge
- Travel opportunities led by Museum scientists to all parts of the world
- Discounts on artwork, books, crafts, jewelry, and other gift items from our Museum shop
- Admission to special features and programs
- A valuable membership card
- Free ticket to our NatureMax Theatre

To Order: CALL TOLL FREE 800-247-5470
(In Iowa) 800-532-1272

Or Write: Natural History Magazine
Membership Services
Box 4300
Bergenfield, N.J. 07621

AMERICAN MUSEUM OF NATURAL HISTORY

Environmental Putdown

by Luther P. Gerlach

PROGRESS AND PRIVILEGE, by William Tucker. *Doubleday and Co.; $17.95; 314 pp.*

In the introduction to *Progress and Privilege*, William Tucker indicates that he is going to tell us about the "social causality" of environmentalism and that this analysis will in turn show that, while environmental problems are serious, they can be overcome. Their solution, he says, lies in finding a "middle ground between the old, unheeding technological progress, and the counter extreme of no-growth and technological regression that has become the norm of the environmental era."

In the chapters that follow, Tucker argues that objective problems of environmental pollution did not produce the environmental movement; rather, social forces played the key role. He suggests that the problems are thus not so real and final, and can be overcome once we know that they have social and subjective roots.

He tells us that the most important social root is class and privilege. People in the upper social and economic classes naturally want to protect their privileges and vested interests, and one way is to resist technological and economic developments that allow others to compete for the same environmental goods. To support their resistance to change, the upper classes exaggerate the complexities and the sensitivities of the environmental system and the risks of changing any part of it. As a result, government and industry impose stifling bureaucracy and regulations to prevent potentially dangerous impacts. This in turn hurts both the have-nots of the world and the entrepreneurs struggling to fight their way up. It actually helps big business, he asserts, which can afford to live with the regulations while the entrepreneurs are squeezed out.

Almost as an afterthought, lest he go too far in renouncing environmentalism, Tucker explains that environmentalists do not always consciously see the connection between their actions and their self-interest. And, he acknowledges, they have made us pay attention to the many real problems produced by industrial society—indeed, they have been right in their concerns as often as they have been wildly wrong. They have, he says in conclusion, given us "a respite, a period when we took time from the business of the world to learn to enjoy nature, appreciate the limits of our accomplishments and reset our bearings." But even in this eulogy, he implies that environmentalists are a luxury we can no longer afford. The age of environmentalism must come to a decent end, and perhaps Tucker wishes to be recognized as one of the pallbearers.

But who or what is it that is being buried? One of the problems with this book is that Tucker never really tells us. He lets us discover in bits and pieces who and what the environmentalists are. He does not present a model of social causality that holds up under scrutiny, let alone that shows that environmentalists' warnings must be exaggerated because they are made by environmentalists.

Tucker begins with the question, Who are the environmentalists? But his answer is only to ask rhetorically, Are they generous enough to distribute their wealth to the poor? And are they virtuous enough to pursue only spiritual values? No, he concludes, they practice not what they preach. Also, they are proponents of specific interests masquerading as general interests. Tucker would perhaps agree with a quip I first heard in California at a 1971 conference on real-estate development: "Environmentalists are people whose battle cry is 'Stop the neighborhood, let the strangers get off.' " He does note that almost anyone is likely to oppose a particular form of economic development that has an impact on his turf and interests. But he explains that environmentalists are different from just anyone opposing development. They constitute a social group that opposes every form of economic growth and progress as a general policy.

This seems clear enough, but later Tucker tells us that such resistance to growth and change has been around a long time, based on aristocratic, agrarian interests. Environmentalism today carries on these interests and, indeed, he notes that Herman Daly, a proponent of a "steady-state economy," comes from the very Southern university community in which this opposition to technological modernization was romanticized in the 1930s by local academics and writers.

We are told that the new environmentalism is a form of suburban agrarianism. Later, though, Tucker says that it springs from a coalition of upper-middle-class people, intellectuals, and students that arose in the 1960s as these groups turned from fighting against poverty and the war in Vietnam to fighting environmental pollution. Their class identity naturally makes them want to fight for noble causes, but when blacks and the poor rejected them and when terrorism and violence beset the antiwar and Black Power movements, they looked, at least subconsciously, for another crusade. The budding environmental movement offered the simple idea that saving the planet was more vital and urgent than solving social problems. It won out in "the competition of ideas." Tucker does not identify what these other ideas were, but he does say that thus environmentalism was born.

So the upper middle class, intellectuals, and students make up the environmental movement, but does Tucker mean all members of these classes or only some? If only some, what makes the difference?

SPECIAL BENEFIT FOR MUSEUM MEMBERS

Eight magnificent natural history books selected expressly for Members of the American Museum of Natural History. Available to Members at large discounts up to 40% off the publisher's price. For your holiday gift-giving convenience, a blank gift card and envelope will accompany every order.

Konrad Lorenz
The Year of the Greylag Goose

Year of the Greylag Goose (Konrad Lorenz)/150 full color phototgraphs/$20.00 (members' price **$13.00**). Lorenz' famous tribute to this lovely bird. "In every sense, this is a beautiful book" —*Publisher's Weekly.*

GALAPAGOS
Islands Lost in Time

Galapagos: Islands Lost in Time/300 full color photos/$30.00 (members' price **$27.00**). "Beautiful and sensitive photographs"—Stephen Jay Gould, *New York Review of Books.*

DAVID ATTENBOROUGH
Life on Earth

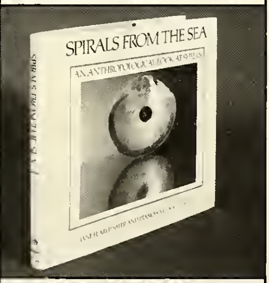
Life On Earth (David Attenborough)/118 full color photos/$22.50 (members' price **$19.00**). "A fascinating introduction to natural history"—*New York Times.*

TO THE ENDS OF THE EARTH

To the Ends of the Earth: Four Expeditions to the Arctic, the Congo, the Gobi, and Siberia/$27.50 (members' price **$23.00**). "A wonderfully evocative book"—*Audubon Magazine.*

MAN AS ART
NEW GUINEA

Man as Art/63 full color plates, 31 duotones/$45.00 (members' price **$40.00**). "We have never received a more beautiful book"—*Primitive Art Newsletter.* "Haunting...spectacular"—*Smithsonian.*


SPIRALS FROM THE SEA
AN ANTHROPOLOGICAL LOOK AT SHELLS

Spirals from the Sea: An Anthropological Look at Shells/More than 60 full color photos/$35.00 (members' price **$29.00**). Based on the Museum's celebrated Hall of Mollusks and Mankind.

The Life of the
by Fred Bruemmer

The Life of the Harp Seal/70 full color photos/$25.00 (members' price **$15.00**). In vivid color photographs, the author chronicles the life of the harp seal from the Gulf of St. Lawrence to the Arctic Sea.

Dinosaurs, Mammoths, and Cavemen

Dinosaurs, Mammoths, & Cavemen: The Art of Charles R. Knight/Over 100 full color plates/$24.95 (members' price **$22.00**). Knight gave us our vision of what prehistoric life looked like. "None has excelled him"—Edwin H. Colbert

Members' Book Program
American Museum of Natural History
Central Park West at 79th Street
New York, NY 10024.

AMB

I would like to order the following books:

Title	Quant.	Price

U.P.S. Delivery, add $2.50 for first book plus $1.00 for each add'l book. FREE DELIVERY with order of 5 or more books.

Total enclosed:

Name:

Address:
(Note: U.P.S. will not deliver to P.O. boxes)

City: State: Zip:

Please charge my credit card account (circle one)
MASTERCARD VISA

Acct. #: Exp. date:
(All numbers, please)

Signature:
Please make checks payable to: American Museum of Natural History

To obtain these special discounts in the Museum Shop, please present this coupon with your membership card. Special discounts apply in lieu of regular members' discounts.

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: BOOKS-ON-FILE
Box 195 Dept. 72
UNION CITY, NEW JERSEY 07087

NATURAL HOLIDAY WREATHS

ENJOY THE FOREST AROMA of fresh balsam fir, handcrafted with double-face, 24", decorated with cones and rainproof velvet, from Santa Claus Lake, Temple, Maine 04984. $18.25 prepaid ($1.00 more west of Mississippi). Perfect gift. Lasts for months after Christmas as closet freshener. Also 12" @ 2/$25 and 48" for $29.

File *Natural History's* Like Fine Books!

Deluxe files hold magazines in first-edition style. Gold-stamped, green leather-like front. Hold one year's subscription. Also supplied for **Smithsonian, Audubon, Scientific American** and many others.

To order, list titles desired, quantities. Postpaid **$6.50 ea., $5.85 ea. for 3 or more.** Send check; or MasterCard or Visa number, expiration date and signature. Mail to Highsmith Co., Box 800NH, Fort Atkinson, Wisconsin 53538. Or call Toll-Free 1-800-558-2110. (In Wisconsin 414-563-9571.)

Free catalog of files with order.

Highsmith

We repeat the enormously popular and unusually interesting outdoors programs to the Andes and the Himalayas where our small groups are expertly led by capable mountaineers:

Inca Trek in Peru

JULY 17 TO AUGUST 1, 1983
AUGUST 7 TO 22, 1983

These expeditions provide the stirring experience of walking along the ancient Inca trail from Cuzco high above the lovely Urubamba Valley, at a leisurely pace over three passes and through fabulous Andean scenery to Machu Picchu, the most dramatically spectacular archaeological site in the world. Before and after the trek, first class hotel accommodations are provided in Lima and Cuzco.

Himalayan Trek in Nepal

NOVEMBER 20 TO DECEMBER 15, 1982
FEBRUARY 5 TO MARCH 2, 1983

These expeditions are unique not only due to the expert leadership but because they combine a trek on foot in the Annapurna region with a trek on elephant back through the Terai jungle, and a canoe trip on the Rapti River. Between the treks, first class hotel accommodations are provided, and the expedition ends with five days in Northern India, visiting Delhi, Agra and Jaipur.

Detailed brochures are available from:

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

What happened to the agrarian aristocrats? Have they become the upper middle class? Tucker does not say. But he declares that the "key to understanding environmentalism" lies in the presence in the movement of "plain old rich people." Is their entry to be understood as the cause or as just one of the causes of environmentalism? Certainly, Tucker can't mean that all "plain old rich people" joined the movement, so what explains the difference between those who joined and those who didn't? Determining this difference seems necessary if one's basic proposition is that the movement and its biases can be explained by class characteristics.

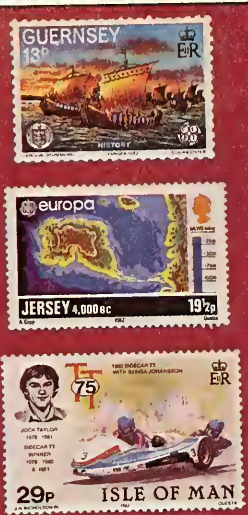
Tucker drops hints about other factors that might motivate environmentalists. One is that there are jobs to be had in the bureaucracy spawned to enforce environmental controls, and that the members of these classes get such jobs. He indicates that bureaucrats are addicted to using deductive reasoning, proceeding logically from known principles. Thus, he says, they quickly lose touch with reality. This he contrasts with the scientific method, which involves using induction to experiment and discover. Does he mean that science doesn't find deduction a useful tool? What method does he use as he seeks to determine social causality? Anyway, he likes scientists much more than bureaucrats and he explains that scientists who were in favor of promoting recombinant DNA research were challenged by environmentalists on the grounds that this research could let loose deadly genetic unknowns. Cambridge, Massachusetts, was a major battleground in this struggle. Tucker recognizes that Harvard and MIT scientists (especially members of a "leftist group," Science for the People) were among those protesting the research but hastens to say these were only second- and third-line faculty and graduate students. The mayor of Cambridge and counterculture activists joined in fighting the research, as did George Wald, a Nobel prizewinner in chemistry. We never learn if all those who fought together against recombinant DNA research are to be considered environmentalists according to Tucker's use of the term. Apparently not, but what makes the difference?

Tucker distinguishes some environmental groups as being neo-Malthusian, others as neo-Marxist, but he never really explains what these distinctions mean, how he knows he's right, or how these differ from still other environmental groups. He also claims that the environmentalists are opposed to interdependence among different peoples and parts of the world. Yet, he identifies Lester Brown and the Worldwatch Institute (which he calls neo-Malthusian) as being environmentalist. While Brown certainly expresses worry about some of the consequences that follow when one country becomes too dependent on resources or assistance from another, he also believes that we live in a "world without borders" in which we must learn to live interdependently. Furthermore, if people call for energy independence for the United States, are they hence likely to be environmentalists? I think that there is not much demonstration of social causality in Tucker's analysis—certainly not enough to explain environmentalist behavior and then to leap to his claim that environmental problems are therefore surmountable.

I happen to think that our environmental problems are capable of resolution, and that analyzing environmentalism as a social force does help us understand why our society has defined the problems and solutions as it has in recent years. But Tucker does not contribute much to this understanding. He presents many interesting examples and some case studies. But he uses these to make propositions that are unwarranted from the evidence or are mutually contradictory. He gets so wrapped up in trying to put down the environmentalists that he doesn't put down his own thoughts coherently. He also assumes that his readers understand so much about the subject that he has no need to define terms or explain his leaps in analysis.

From his examples, we can piece together a model of environmentalism in which different types of involved persons and groups—including citizens interested only in protecting immediate self-interest and the professional environmentalists—are ranged along a continuum and then analyzed as interacting in networks. We can show how these groups have adopted ideas—such as that there are limits to growth and that environments are systems of interdependent parts—and used them both as pragmatic tools and as motivating, legitimizing, and integrating concepts. Such an approach has helped me in my studies of the factors that pull people from a variety of classes, interests, and backgrounds into the environmental movement. In my view, this approach is superior to an attempt to explain what pushes people into environmentalism, especially one relying on notions as general as social class and as weak as subconscious motivation.

Luther P. Gerlach, professor of anthropology at the University of Minnesota, has closely followed the environmental movement in the United States.



Just three of the 80 or more unique stamps in the 1982 Collectors Portfolio.

The Official Postal Agent for GUERNSEY, JERSEY and the ISLE OF MAN has authorized The Royal Philatelic Collectors Guild to accept advanced subscriptions for their . . .

Official Philatelic Collectors Portfolio

The Advance Subscription Price of $24.95 (per quarter) for the Complete 1982 Three Country Collection is guaranteed through December 31, 1982 only.

The Royal Philatelic Collectors Guild proudly presents an opportunity for you to enjoy the historically important and aesthetically beautiful stamps of Guernsey, Jersey and the Isle of Man. Informed philatelists eagerly collect the postal issues of these islands not only for their artistic excellence but because of their past investment performance. The 1969 Guernsey and Jersey issues, originally sold for approximately $25, are now available only on the after-market at a cost of $400 or more.

The enchanting Islands of Guernsey and Jersey lie in the English Channel nestled off the west coast of Normandy. With over 1000 years of recorded history these romantic isles, where kings and queens stopped to rest, arise like green jewels from the sea. Immersed in scenic splendor the Isle of Man, located in the Irish Sea midway between Northern England and Northern Ireland, is a country of contrasting scenes. Spotted with ancient castles, the landscape is surrounded by lush green hills, quaint villages, sandy beaches and fish-laden crystal-clear streams.

The limited postal issues of these charming islands, philatelically independent for a little more than a decade, have become increasingly important to astute collectors. These widely collected stamps depict not only the romance and beauty of their individual Isles, but also themes with lasting historic revelance. The elegant 1981 Royal Wedding issues, so popular among collectors all over the world, are now only available on the after-market from dealers or other collectors.

The stamps in the Collectors Portfolio will be sent in four shipments, approximately three months apart. Each shipment contains a handsome display sheet to maintain the stamps in the mint-state condition so prized by collectors and investors. All portfolios are sold on an unconditional 30-day, money-back guarantee.

Order now and start building your heirloom collection today!

Priority Reservation Form

NH1182

Royal Philatelic Collectors Guild
535 Fifth Avenue
New York, New York 10017

☐ Please enter my advance subscription for the complete 1982 Collectors Portfolio. The collection contains all the stamps issued by Guernsey, Jersey and the Isle of Man during 1982. I will be billed on a quarterly basis for only $24.95 (per shipment) plus $1.50 postage, handling and insurance.

☐ I enclose $24.95 (check/money order) for my first shipment plus $1.50 postage, handling and insurance.

☐ Charge my credit card account $24.95 plus $1.50 postage, handling and insurance.

(New York residents add sales tax)

☐ Also, please reserve for me the complete 1983 Collectors Portfolio. The collection will contain all the stamps issued by Guernsey, Jersey and the Isle of Man during 1983.

☐ I enclose a deposit of $10. ☐ Charge my Credit Card account $10 (I have filled in my account number below).

I understand that I may cancel this subscription at any time.

☐ Charge my Credit Card account

☐ Visa ☐ MasterCard

Credit Card No. ____________

Signature ____________

Exp. Date ____________

Name ____________

Address ____________

City ____________

State ____________ Zip ______

RAGG KNIT SLOUCH HAT

Our Ragg Knit version of the classic "bucket-crown" Irish field hat. Knit from 85% lanolin-rich wool for warmth and water repellency, 15% nylon for strength. Folds for stuffing in pocket or pack. One size. **Color:** Salt & Pepper. **$14.95** ppd.

Order Today! Money Back Guarantee!

Here is my check or money order for $________
(Add sales tax for delivery in CA, CO, D.C., IL, MI, PA, WA).
☐ MC ☐ VISA ☐ AMEX
Card No.________ Exp. Date______
RUSH my #1996 Ragg Knit Slouch Hat.
Name________
Address________
City________
State ______ Zip ______
☐ Send me your FREE outdoor catalog.
Stores throughout the U.S.

Eddie Bauer®

Dept. FNH, Fifth & Union, Seattle, WA 98124

Enjoy the romance. . .
A luxurious color catalogue of the latest American and European lingerie fashions. Order yours today!
Victoria's Secret
designer lingerie

Send $3 for a year's subscription of catalogues to Victoria's Secret, Dept. NH-11, Box 31442, San Francisco, CA 94131

Letters

France's Parks—and America's

Joseph Sax presents an intriguing challenge to the managers of, and visitors to, America's parks ("In Search of Past Harmony," August 1982). Much can be learned from the French experience with regional parks, where the approach is to embrace a network of rural communities in an area of outstanding landscape value. The British have followed a remarkably similar style of countryside management.

American admirers of the European approach may have to wait a long time before we can implement these ideas. The first challenge is to convince federal or state policy makers that government must spend money to train artisans in traditional skills, to employ them in the maintenance of vernacular architecture, and to subsidize farming operations to produce traditional liquors or cheeses.

The second and larger challenge is to convince rural voters to accept a comprehensive, regional approach to land-use planning. Strict controls are essential to avoid roadside commercialization and large vacation-home subdivisions; they are even necessary to prevent fields and pastures from sprouting new crops of houses for local consumption.

In the northeastern United States, the closest parallel to the French and British experience is the Adirondack State Park, which manages to survive with a mixed pattern of lovely terrain and undistinguished villages and touring centers. This "park" is 60 percent privately owned and covers 9,000 square miles (almost the size of Vermont). The park agency, established a dozen years ago, reviews all projects with a potential regional impact, regardless of whether they occur within towns or in areas of semiwilderness. Facing local suspicion, officials there have had to tread a careful line, and have been burned in effigy at least once by rural landowners.

It is likely that no regional park in this country could manage to offer the variety of hiking opportunities found in Europe, where tourists can ramble among working farms and traditional villages. Such an experience is possible overseas because of the elaborate network of public footpaths and rights-of-way that evolved many centuries ago when most people walked from field to field and from village to village. The hiker who strays from the public roadway in New England is usually greeted with signs proclaiming: Private Property—No Trespassing. In areas not adequately covered by ancient footpaths,

Lubéron regional park, France

Martine Franck, Magnum

British authorities coax landowners to sign "access agreements." These provide financial compensation to the landowner for damaged fences, trampled crops, or livestock disturbance caused by the minority of inconsiderate recreationists. This may be a fruitful course for us to pursue on this side of the Atlantic.

Randall Arendt
Senior Planner,
Southern Maine Regional
Planning Commission
Sanford, Maine

Third World's Woes

"Human Wants and Misused Lands" (June 1982) was an eloquent portrayal of the deteriorating human, ecological, and economic environments in the varied countries misleadingly lumped together as the Third World. Having spent over seventeen years in development work in Africa, I have witnessed the deterioration of both the rural and urban environments there from year to year. What Erik Eckholm's article fails to point out clearly enough are the main reasons for the failure of billions of dollars of aid poured into the underdeveloped countries to reverse the trend toward disaster.

With all the best intentions, aid in the form of loans only sinks these countries into a deeper and deeper slough of debt. More than 50 percent, and in some cases close to 100 percent, of new aid is used in one way or another to repay old loans.

Not a few foreign-aid programs are designed primarily to achieve political gains rather than tailored to the true development needs of the recipients. The donors bow to the desires of underdeveloped countries and invest in costly, uneconomic projects that not only waste scarce financial resources but that are, in many instances, detrimental to development. An excellent example is the project for development of the Senegal River Basin by a joint agency of Senegal, Mali, and Mauritania. Despite advice from individual experts, the World Bank, and the U.S. Bureau of Reclamation that the project was both uneconomic and unnecessary, a majority of the potential donors agreed to support it. The opposition proposed sim-

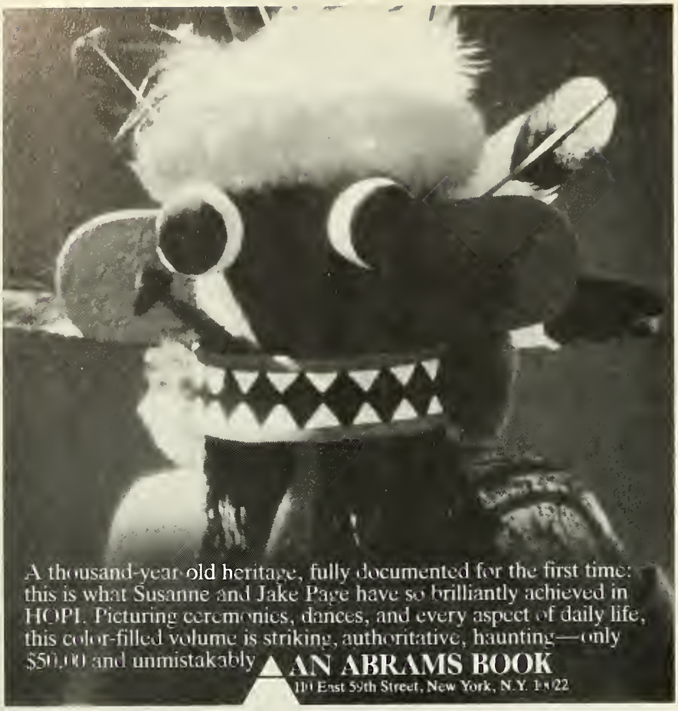
CHIVAS BROS
IMPORTED
PRODUCED IN SCOTLAND
LOCHAN ORA
LIQUEUR
CHIVAS BROTHERS LTD

The Chivas Regal of Liqueurs.

Chivas Brothers make the world's finest Scotch. And the same renowned Chivas quality and tradition goes into its equally-regal Lochan Ora Liqueur. With a unique taste all its own. Lochan Ora is to be lingered over—sipped slowly, savored fully. It's expensive but, then, good taste invariably is.

Lochan Ora.
The Imported Liqueur from Chivas Brothers.

70 PROOF • IMPORTED BY GENERAL WINE & SPIRITS CO., N.Y., N.Y.



A thousand-year-old heritage, fully documented for the first time: this is what Susanne and Jake Page have so brilliantly achieved in HOPI. Picturing ceremonies, dances, and every aspect of daily life, this color-filled volume is striking, authoritative, haunting—only $50.00 and unmistakably **AN ABRAMS BOOK**
110 East 59th Street, New York, N.Y. 10022

MAJOR CONSTRUCTION SEAMS FACTORY SEALED
WIND FLAP SECURES OVER TWO-WAY YKK ZIPPER.
TWO ZIPPER-SECURED POCKETS (ONE INSIDE).
FULLY ADJUSTABLE GUSSETTED VELCRO CUFFS.
STORM SKIRT PREVENTS HEAT LOSS.

Item: The Trinity Alps

DESCRIPTION: Gore-Tex™ Thinsulate® Foul-Weather Parka.

SPECS:

Fabric: Gore-Tex™ laminated to Exacta™ Cloth.
Inside: Gore-Tex™ lets perspiration escape, but completely blocks rain, mist, etc.
Outside: Durable, snag-proof Exacta™ Cloth for long wear.
Insulation: Thinsulate® (200 gms./sq. meter). Extends to full length and hood. Factory-sealed major construction seams eliminate leakage.
Lining: Nylon taffeta.
Pockets: Total—6, 2 zipper-secured upper pockets, 2 Velcro-secured lower cargo pockets with "bellows" pleats for extra capacity, and 2 hidden Thinsulate® lined hand-warming pockets.
Hood: Permanent full cut for wear over headgear or alone. Drawstring provides weather seal. Soft visor shields glasses/goggles from rain.
Gen. Notes: Men's S to XXXL. Women's XS to L. Made in Portland, Oregon.

For catalog, send $1 to:
Columbia Sportswear,
6600 North Baltimore,
Portland, Oregon 97203

Columbia Sportswear Company Portland, Oregon

Thinsulate

DUPONT ZEPEL RAIN/STAIN REPELLER

GORE-TEX fabric

We don't just design it. We engineer it.

Thinsulate® is a registered trademark of 3M. Gore-Tex™ is a trademark of W. L. Gore & Assoc., Inc. ZEPEL® is a registered trademark of Du Pont.

pler and less costly solutions to the pressing problems of irrigation and electric-power production, but the desire prevailed for a gigantic dam, a river transport system, and a massive water supply for agriculture, industry, and urban use, all dependent on unrealistic projections of mining, industrial, and agricultural production.

Even more damaging is the distraction of governments from their internal problems by their excessive interest in distant international events. This, combined with internal corruption and the maintenance of high standards of physical comfort for top government officials, squanders intellectual, physical, and financial resources that should be put to better use.

The enormous profits of the OPEC cartel and the international oil companies have been more damaging to the underdeveloped nations than to the developed world. Also, the inequitable tax structure of all the underdeveloped countries falls heaviest on the lowest income groups. The governments rely heavily on indirect taxes to compensate for revenues they are unable or unwilling to collect from businesses or high-income individuals, draining the meager incomes of the poor.

Some naïvely believe that the main concern of the leadership of the poor countries is the welfare of the citizenry and its economic advancement. This is true only in an abstract sense. The first concern is the well-being of the military. By purchasing the loyalty of the military, the leaders hope (a hope not always fulfilled) to perpetuate their rule. The second concern is to provide the basic necessities for the population of the major urban centers at a reasonable price in order to avoid political unrest. The welfare of the farmer, the remote villager, the herdsman comes last, if at all.

All these factors help prevent economic aid from achieving the shining results once envisioned.

Samuel Lubin
Beersheba, Israel

To Save the Snow Leopard

If Orville Schell meant to convey an appreciation of the plight of endangered species in his article "Journey to the Tibetan Plateau" (September 1982), he failed miserably. He writes: "For the next several days we dine on snow leopard soup." That action may have conveyed to the Tibetans an impression of support for the killing of this magnificent species.

Schell gives no alternatives to the extinction of the snow leopard. But education programs on the need for conservation of endangered species do work, especially if the people involved can be shown that preservation is to their benefit. Mr. Schell gives no indication that he made any effort, however tentative, to help the Goloks understand the case for saving the snow leopard.

Helen Freeman
President,
International Snow Leopard Trust
Bellevue, Washington

Shared Birds

"Northern Birds at Home in the Tropics," by John W. Fitzpatrick (September 1982), draws attention to the urgent need to protect the tropical wintering habitats of our migratory birds. Current tropical deforestation trends threaten not only thousands of unique tropical species but also many of the one-third of North American birds that migrate to the tropics.

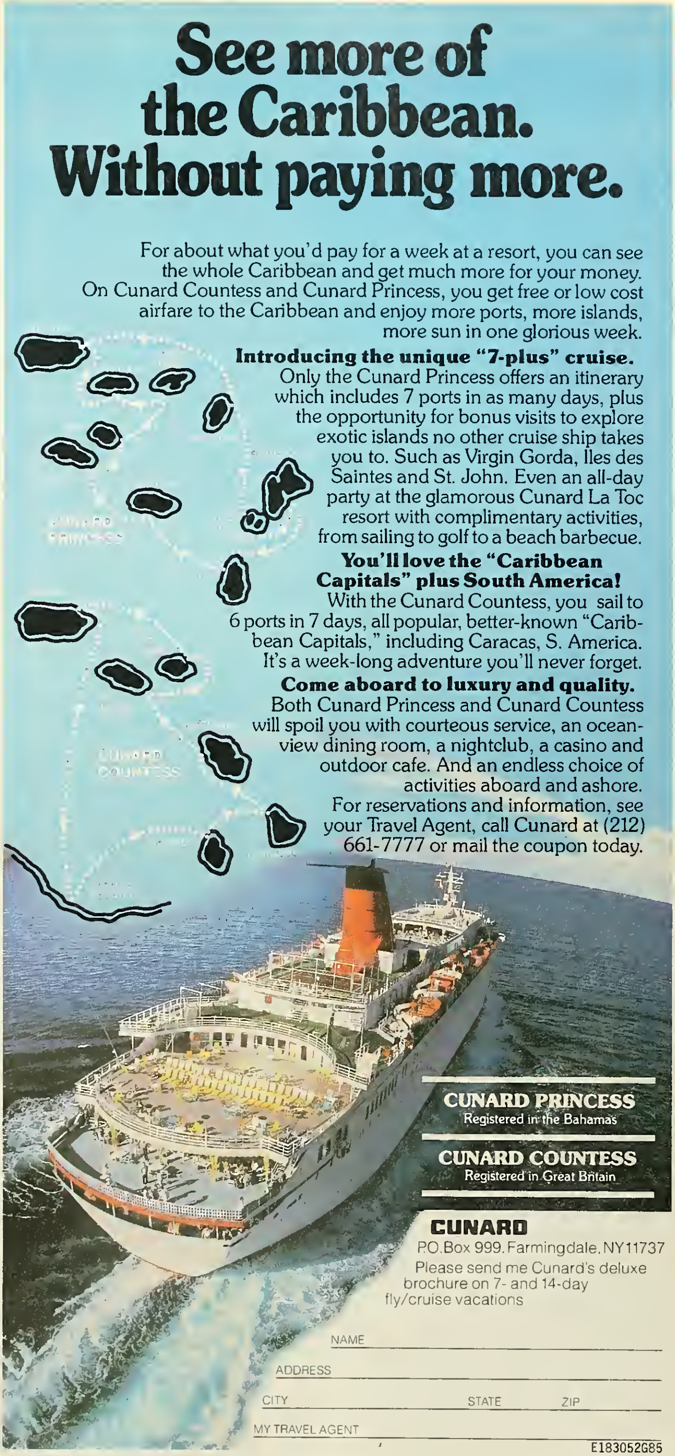
Many of the Latin American countries in which migratory birds winter will lose half their forests by the century's end unless preventive measures are stepped up. Tropical coastal areas also face development pressures. Protection of coastal wetlands and estuaries is especially critical for migratory shore birds, which winter in concentrations far greater than those in their northern breeding grounds.

On the positive side, there has recently been a significant growth in commitment and ability to address environmental problems on the part of Central and South American countries. Over the last decade, many governments have created parks and wildlife departments where none existed before. In the same period, the total area set aside in parks and protected areas has tripled, with Costa Rica developing a park system more extensive in relative terms than that in the United States.

Still, insufficient attention has been paid to protecting the wintering habitat of our shared migratory birds. I know of no park created exclusively for this purpose, and research on the wintering requirements of migratory birds has lagged far behind study of their breeding grounds. To help rectify this neglect, the World Wildlife Fund recently began a program to identify those species most affected by tropical habitat loss and to help conserve critical wintering grounds.

As individuals, we can help through private conservation organizations; as a nation, we can assist our southern neighbors in their declared programs to conserve forests and wildlife. Before it is too late, we must join forces with those countries to protect migratory birds, a resource shared between us.

Russell E. Train
President, World Wildlife Fund-U.S.
Washington, D.C.



See more of the Caribbean. Without paying more.

For about what you'd pay for a week at a resort, you can see the whole Caribbean and get much more for your money. On Cunard Countess and Cunard Princess, you get free or low cost airfare to the Caribbean and enjoy more ports, more islands, more sun in one glorious week.

Introducing the unique "7-plus" cruise. Only the Cunard Princess offers an itinerary which includes 7 ports in as many days, plus the opportunity for bonus visits to explore exotic islands no other cruise ship takes you to. Such as Virgin Gorda, Iles des Saintes and St. John. Even an all-day party at the glamorous Cunard La Toc resort with complimentary activities, from sailing to golf to a beach barbecue.

You'll love the "Caribbean Capitals" plus South America! With the Cunard Countess, you sail to 6 ports in 7 days, all popular, better-known "Caribbean Capitals," including Caracas, S. America. It's a week-long adventure you'll never forget.

Come aboard to luxury and quality. Both Cunard Princess and Cunard Countess will spoil you with courteous service, an ocean-view dining room, a nightclub, a casino and outdoor cafe. And an endless choice of activities aboard and ashore.

For reservations and information, see your Travel Agent, call Cunard at (212) 661-7777 or mail the coupon today.

CUNARD PRINCESS
Registered in the Bahamas

CUNARD COUNTESS
Registered in Great Britain

CUNARD
P.O. Box 999. Farmingdale, NY 11737
Please send me Cunard's deluxe brochure on 7- and 14-day fly/cruise vacations

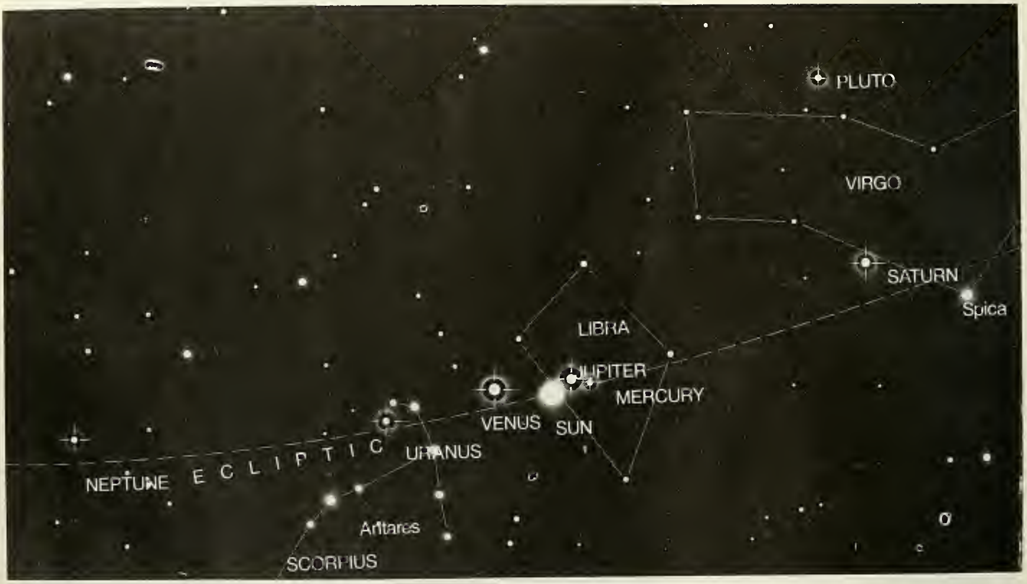
NAME
ADDRESS
CITY STATE ZIP
MY TRAVEL AGENT

E183052G85

Celestial Events

by Thomas D. Nicholson

Helmut Wimmer



We don't ordinarily see planets when they are in the sky during daylight or very bright twilight. Venus is an outstanding exception. When favorably located it can be seen at noon without optical aid. However, the general rule applies to the other planets this month. The illustration shows their positions relative to the sun and the background stars at mid-month. Relative to the stars behind them, the sun and planets are moving slowly, and as they move the sun comes into line with seven of the eight planets in our sky within a two-month period from mid-October to mid-December. But the stars and planets shown here are above the horizon this month only during daylight and bright twilight, so the exceptional show they are putting on will go unseen.

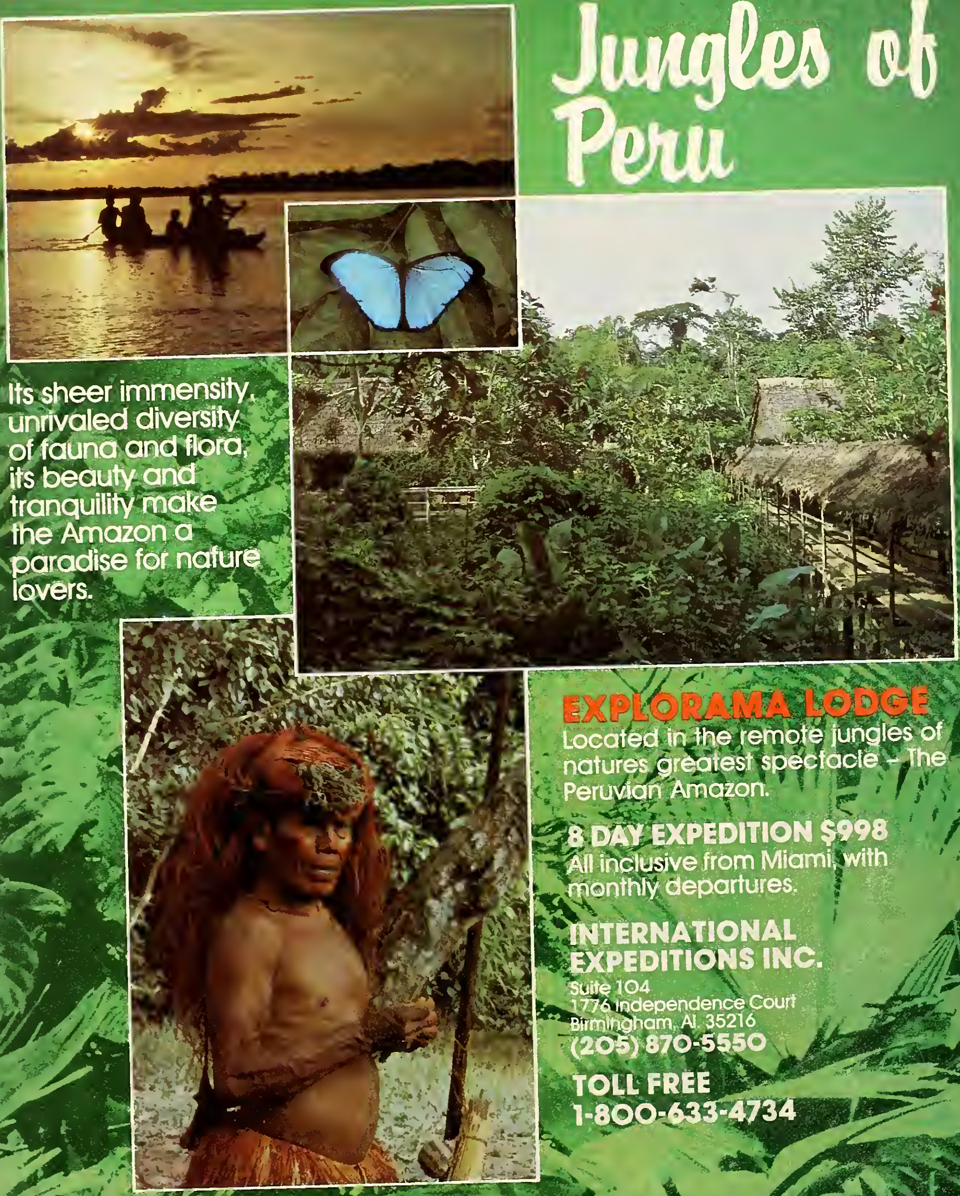
All Month October wasn't very good for observing the planets, but November is even worse. Still, one exceptional planetary event does take place this month (actually, it began in late October). Six of the eight planets (we don't count the earth among the planets we see in the sky) are in line with the sun (conjunction) at some time between October 18 and November 27. The six are, in order: Saturn on October 18, Pluto on October 20, Venus on November 3, Jupiter on November 13, Mercury on November 19, and Uranus on November 27. The group includes two inferior planets (Mercury and Venus, nearer to the sun than the earth), both shifting into the evening sky, and four superior planets (Jupiter, Saturn, Uranus, and Neptune), all shifting from evening to morning stars. And, by adding a month, you can include Neptune, which is in conjunction with the sun on December 19. Unusual, certainly, but is this of any real significance other than to star gazers? None at all.

One consequence of this happenstance is, of course, that you can't see much of the planets in November since they spend most of their above-the-horizon time in daylight. Even Mars, the *only* planet that isn't in conjunction with the sun during this period, spends only one-fourth of its above-the-horizon time in darkness.

November 1: Full moon appears among the stars of Taurus tonight. This is the hunter's moon, similar to the harvest moon of a month ago. But the retardation

AMAZON

Jungles of Peru



Its sheer immensity, unrivaled diversity of fauna and flora, its beauty and tranquility make the Amazon a paradise for nature lovers.

EXPLORAMA LODGE
Located in the remote jungles of natures greatest spectacle – The Peruvian Amazon.

8 DAY EXPEDITION $998
All inclusive from Miami, with monthly departures.

INTERNATIONAL EXPEDITIONS INC.
Suite 104
1776 Independence Court
Birmingham, Al. 35216
(205) 870-5550

TOLL FREE
1-800-633-4734

Faucett
PERUVIAN AIRLINES

Where in the world can you save money on a tropical vacation?

Now a vacation in peaceful Costa Rica is a better value because your dollar exchanges for twice as much as last year. Get away to our unspoiled beauty and year-round spring climate without blowing a bundle. For information write the Costa Rica Tourist Board, 200 S.E. First St., Miami, FL or call 800-327-7700, (800-432-7502 in FL), the airline that's happy to please you...LACSA.

LACSA
The Airline of Costa Rica

COSTA RICA
we have so much to share

Questers for 1983

Travel with a purpose. Learn and discover. Search out plants and animals, birds and flowers. Explore rain forests, mountains and tundra, seashores, lakes and swamps. With Questers you will have ample time to photograph, absorb and reflect. Naturalist guides, small tour parties, first-class accommodations.

Worldwide Nature Tours
1983 Departures

The Americas

Okefenokee Swamp: 12 days, 4/17 • Everglades: 11 days, 4/7, 11/3 • Hawaii: 15 days, 2/10, 3/24, 10/20, 12/22 • Alaska: 17 days, 6/24, 7/12 & 30 • Pacific Northwest: 12 days, 6/20, 8/8 • Superior Forest Canoe Trip: 9 days, 7/9, 8/13 • Canyonlands: 11 days, 5/6, 10/7 • Northwest Canada: 16 days, 7/1 • Manitoba (Churchill): 12 days, 6/20 • Newfoundland: 16 days, 6/12 • Southern Mexico: 14 days, 2/13, 12/18 • Panama & Costa Rica: 14 days, 2/14, 3/21, 12/19 • The Amazon: 17 days, 1/9, 5/8, 7/3 & 31, 10/2, 11/13 • Ecuador & Galapagos: 16 days, 2/9, 4/13, 7/6 & 27, 10/19, 12/21 • Peru: 17 days, 7/17, 11/6 • Patagonia: 22 days, 1/10, 11/7 • Trinidad & Tobago: 11 days, 3/7 & 21, 11/7 & 21.

Europe

Iceland: 16 days, 6/17, 7/8, 8/5 • Islands/Highlands of Scotland: 21 days, 6/2, 7/14 • Switzerland: 17 days, 7/15, 8/12 • Greece: 19 days, 3/28, 9/19 • Spain: 20 days, 4/15, 9/16.

Asia and Africa

Japan: 23 days, 6/3 • Sri Lanka: 18 days, 2/18, 11/18 • Walking in Foothills of Western Himalayas: 19 days, 4/14 • Himalayas: Nepal, Sikkim & Bhutan: 23 days, 3/17, 10/6 • Kenya: 23 days, 2/3, 7/21, 10/20 • Zimbabwe & Botswana: 19 days, 5/26, 7/7, 10/13.

Oceania and Australasia

Australia & New Zealand: 28 days, 2/12, 10/1 • New Zealand & the Milford Track: 22 days, 2/11, 11/11 • Papua New Guinea: 22 days, 5/20, 8/5, 11/4.

Write for the 1983 Questers Directory of Worldwide Nature Tours. If a particular tour strikes your fancy, ask for its Detailed Itinerary.

QUESTERS
Questers Tours & Travel, Inc.
Dept. NH, 257 Park Avenue South
New York, NY 10010 • (212) 673-3120

of rising time of the hunter's moon from night to night is so much less than usual that moonlight seems to last from dusk to dawn for several nights in a row, instead of only on the night of the full moon. Mercury is in conjunction with Saturn today, in Virgo. The two planets are technically morning stars, but they are poorly placed for viewing.

November 2: The weak, diffuse Taurid meteor shower is at maximum today, but that isn't saying much. The best estimate is about 15 shower meteors per hour, but bright moonlight during morning hours won't help visibility. The moon tonight is still in Taurus. The Pleiades (a fuzzy cluster of dim stars) are above and to the moon's right, and Aldebaran, Taurus' brightest star, is below and to its left.

November 3: Venus is in superior conjunction, in line with, but beyond, the sun. The planet leaves the morning sky and enters into a long period as an evening star.

November 4: Early today the moon is at perigee (nearest the earth). In eastern Taurus, it moves tonight between El Nath and Zeta Tauri, the stars that mark the "horns" of Taurus above the V-shaped star cluster, known as the Hyades, that traces the Bull's face.

November 5: The gibbous moon rises within the stars of Gemini at about 8:30 tonight. It moves into line with Pollux and Castor, the "twin" stars, on the night of the 6th. Pollux is the lower and brighter of the two stars.

November 7: Last-quarter moon rises late, at about midnight, in Cancer.

November 8–9: Early on the evening of the 8th, the moon passes the star Regulus, in Leo, but by the time the two rise after midnight the star is clearly to the moon's right.

November 13: Spica is to the moon's right this morning and Saturn is to its left and below it. Jupiter is in line with the sun (conjunction), shifting from the evening to the morning sky as the sun moves east past it.

November 15: New moon is in Scorpius.

November 17: The Leonid meteor shower reaches maximum this morning when the sky will be dark and moonless. This most famous of all showers produces only about 15 meteors per hour, but many are bright. It owes its reputation to a spectacular past. Veritable "storms" of meteors, numbering in the dozens per minute, were reported in 1799, 1833, 1866, and most recently in 1966. But little more than the usual shower is expected this year.

November 18: The young waxing crescent moon is in the west early tonight. It is above the stars of Sagittarius, but the moon and stars set so early the constellation will not be visible.

November 19: Mercury moves past the sun today, beyond it in our sky, to the position known as superior conjunction. The planet now becomes an evening star. Mars and the moon are in conjunction at about 4:00 P.M., EST, and the moon covers the planet (an occultation) as seen from the southern half of the United States, Central America, and part of South America. However, it is a daytime occultation as seen from the northern part of the United States.

November 20: The moon is at apogee (farthest from the earth) early today. Tonight it rises as a waxing crescent in Capricornus.

November 23: Having moved on into Aquarius, the moon is at first-quarter phase. The brightest star above it is Enid, in Pegasus. The Square that marks the "flying horse" is well above and to the moon's left. The bright star below and to the left of the moon is Fomalhaut, in Piscis Austrinus, the constellation of the Southern Fish.

November 25: Tonight's waxing gibbous moon is above the horizon at sundown in Pisces, located just above the vernal equinox. (Another name for the vernal equinox is the "first point of Aries." But the moon will not be in Aries until the nights of the 27th and 28th, when it will be well below the constellation's brightest star, its "first point." The reason for the second name is that the vernal equinox was near the principal star of Aries some thousands of years ago. But since then, the precession, or wobbling, of the earth's axis has caused the equatorial plane to shift around the sky and caused the equinox [where the equatorial plane crosses the earth's orbital plane] to shift west from Aries into Pisces, where it is now.)

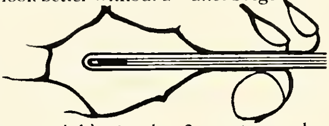
November 27–28: Two second-magnitude stars above the moon mark the position of the constellation Aries the Ram. Its bright stars are Sheratan, the brighter, to the right, and Hamal to the left. The Square of Pegasus is to their right, and three stars stretched out in line above them mark the constellation Andromeda.

November 30: Taurus is the home of the full moon again tonight, the second full moon of November. The moon passes above Aldebaran, the bright red star of Taurus, early in the evening, and moves away from Aldebaran during the morning hours.

Editor's Note: The Sky Map in the October issue shows the evening constellations and stars for this month and gives the times for use.

Thinner Wallets

Until recently the thinnest wallets were made from expensive seal skins. Then a new material was developed—Oxford Nylon. Pin Craft Corporation patented a unique line of wallets out of this durable woven material. Consumers' Research Magazine did an extensive study on wallets and concluded by giving their top recommendation to Oxford Nylon wallets. Oxford Nylon does not have the thickness of leather, yet it is more durable, lighter, longer wearing, flexible and very thin. Thus the Oxford Nylon wallet is more comfortable to wear, and your clothes look better without a wallet bulge.



Available in the 3 most popular styles, all have window cases for 16 or more credit cards. You can try an Oxford Nylon wallet with the understanding it can be returned within 31 days for full refund. The wallets are sold regularly (since 1973) through the Wall Street Journal. Three year guarantee. Great gifts for friends and associates. Give yourself a 10% discount when ordering 3 or more.

Sportster — Smallest and thinnest. A card-case and billfold, for hip or shirt pocket. $7.00

Classic—Thinnest hip pocket wallet with a section for money and notes plus two hidden compartments. $10.00

Executive—Coat or hip wallet with a handy stacking rack for credit cards and a 3½x5 picture window. Two hidden compartments. $12.00

Put the model letter S, C, or E, and quantity after the color(s) you want:
Send the coupon or information to:

Pin Craft Corporation Dept. NH 7
16 N. Mentor Ave., Pasadena, CA 91106

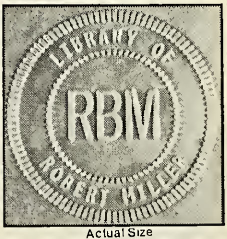
Black________ Brown________ Tan_____
Burgundy______ Dark Green______
Navy Blue________. Add $2.40 for embroidered initials________ in gold ☐ or silver ☐ gift wrap ☐. Made in U.S.A.
Name (Print) ________________
Address ________________
________________ Zip________
Check ☐ M.O. ☐ MasterCharge ☐ Visa ☐
Carte Blanche ☐ Diners ☐ Expires_____
Card # ________________
To speed credit card orders, call toll free nationwide (800) 423-4541. In Calif., AK, HI, toll call (213) 793-2101.

The Mark of a True Book Lover

AVAILABLE BY MAIL ONLY
Sale! SAVE 25%

Thousands sold at $20 or more!

Now Only $14.95 EACH

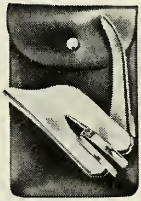


Actual Size

This is the same heavy duty, chrome plated embosser used by librarians to mark and identify books.

Now you can have one with your own name and initials on a 1½" diameter seal. It's easy to use. . . insert the page, squeeze the handle and "LIBRARY OF (your name)" and initials will be clearly embossed (see photo).

This quality embosser is fully guaranteed and comes with a handy storage pouch.



Since this item has to be personalized, please allow 3 to 5 weeks for delivery.

How do you want your seal to read? INITIALS
Print name and initials exactly the way you want them to appear.
NAME
For additional embossers, simply print names and initials on a separate sheet of paper.

Check One
☐ A check or money order is enclosed
☐ Please charge this purchase to:
☐ VISA ☐ American Express ☐ MasterCard
Account #
MasterCard 4 digits above your name
Exp. Date ________ Signature ________

BARNES/SALE
& NOBLE/ANNEX
126 FIFTH AVENUE DEPT. E 439
NEW YORK, N.Y. 10011

Please send me________ embosser(s) at only $14.95 each plus $1.75 each for postage and insurance. (N.Y. and N.J. residents: Please add sales tax.)

Name ________________
Address ________________
City ________________
State ________ Zip ________
Offer good only in the continental U.S.A. 0038158
© 1982, Barnes & Noble Bookstores, Inc.

The Red Deer of Rhum

On a Scottish island, observations of deer, from birth to death, are leading to a better understanding of how natural selection works

by Tim Clutton-Brock

As Charles Darwin observed, natural selection operates wherever individuals of one genetic composition are better at reproducing than those of another. Any inheritable characteristics that improve an individual's chances of reproductive success will, over many generations, spread throughout the species.

This raises an intriguing possibility. If we could measure reproductive success in wild animals and identify why some individuals breed successfully while others fail, we would be watching natural selection at work. Even where the factors causing differences in breeding success are not inheritable, measurements of reproductive success should provide us with a better understanding of the costs and benefits to the animal of different characteristics and of why particular traits are more developed in some species than in others. Unfortunately, natural selection usually operates through differences in *lifetime* breeding success—and measuring lifetime breeding success in wild animals poses many practical problems.

Think, for a moment, of trying to measure the number of surviving offspring produced by the males and females of a wild animal population over their lifetime. We would need to recognize large numbers of individuals, to watch breeding behavior closely enough to measure the number of females impregnated by each male and the number of young borne by each female, and to keep up records until all the individuals in the initial population had died.

This is a tall order for any fieldworker and is not possible for many animal species. With many insects, for example, individuals cannot be followed consistently, and their breeding behavior cannot always be observed in the wild. The same problems apply to many species of rodents and birds. And while the large mammals are often both visible and easily recognized as individuals, their life spans are often considerably longer than those of most research projects—or even of researchers themselves—and many of the most visible species cover hundreds of square miles in the course of their seasonal movements. Small wonder, then, that no field study has yet measured lifetime reproductive success in both sexes for any wild animal.

More than ten years ago, Fiona Guinness and I set up a study of red deer to help fill this gap. Red deer, which are usually regarded as belonging to the same species as the American elk, or wapiti, are an ideal subject for several reasons. They are common throughout Scotland; even excluding those on deer farms and forestry plantations, some 260,000 red deer live on the open, heather-dominated moorland that covers the bulk of the Highlands. They are easy to observe and unlike many other ungulates living in open habitats, they do not migrate widely. They can be easily recognized from idiosyncracies of face shape and coat color, have short and regular breeding seasons, and most females (hinds) copulate only once a year, conceiving a single calf. And they don't live too long—stags die mostly between the ages of nine and eleven; hinds generally die between eleven and thirteen.

We based our study on the island of Rhum, a national nature reserve lying twelve miles off the northwest coast of Scotland, between the isles of Skye and Mull. Rhum is about eight miles long by five wide, with hardly a mature tree on it. In the eighteenth century, it provided a home for more than four hundred Scottish clansmen, but in the first quarter of the nineteenth century, the entire population, encouraged by their landlord, left the island, many of them emigrating to Canada. After this, Rhum was used first for sheep grazing and later as a sporting estate until it was made a national nature reserve in 1957. Today, it supports a population of about 1,500 red deer and eight human families employed by the British Nature Conservancy Council.

Fiona and I made our base at Kilmory in the north of the island. After we had learned to recognize all 300 individual deer that regularly used our study area, we set about measuring each animal's reproductive success. The success of hinds can be measured without difficulty. By censusing the hind population each day during the June calving season we are able to determine when each female calves; and by waiting until mothers temporarily

L.R. Dawson; Bruce Coleman

Tim Clutton-Brock

Two stags lock horns in a test of fighting ability. The winner of such battles is usually the larger stag, and the prize is access to females. Only a few mature stags are able to secure and maintain harems.

leave their calves in order to feed, we can catch, weigh, and mark the calves with little disturbance. Regular censuses of the study population allow us to monitor the growth, survival, and reproductive performance of each calf that is born.

Measuring the breeding success of stags is harder. During the October rut, successful stags defend harems of up to thirty or more hinds, and each day we record the size of each stag's harem and the identity of the females in it. With knowledge of the birth date of each calf and the identity of its mother, we can then back-date by the average gestation period (236 days for male calves, 234 for females) to identify the stag that held the mother in his harem on the day she conceived. However, gestation length often varies by up to five days either side of the average. To take this into account, we identify all the stags that held the calf's mother during the 11-day period surrounding the estimated date of conception, and allocate to each stag a score proportional to the number of days for which he held the mother. Thus a stag that held the mother in his harem for 11 out of 11 days would score one; while one that held her for only 7 days would score seven-elevenths of a calf, and so on. This method, while cumbersome, provides a reasonable estimate of the breeding success of different stags, and its results correlate closely with most other ways of estimating success, including the number of times each stag is seen to copulate.

Today, we know the identity, age, and breeding success of virtually all the 300 deer that use the northern part of Rhum. Every animal has a four-letter code name and its own subfile on the Cambridge University computer. As each dies, we close its file and calculate the number of surviving offspring it produced during its lifetime. Among stags, this ranges from zero to about thirty calves that survive at least one year. Only some members of a stag's harem conceive, and the maximum number of calves a stag can produce in a season does not appear to be more than six or seven. In addition, because of the intensity of competition between individuals, only mature stags in their prime are able to secure harems, and few animals breed successfully for more than four years during their life span.

The lifetime breeding success of hinds varies less widely—from zero to about twelve surviving calves. Given that hinds never produce more than one calf a year, even this range is wider than we had anticipated. This is partly because some hinds breed successfully from the age of three until they are fifteen or more years old, while others consistently fail to produce surviving calves throughout their lives. Contrary to previous suggestions, the more successful breeders live longer than the average animal.

Perhaps our most striking finding is the extent to which the factors governing breeding success differ between males and females. A hind's breeding success depends mainly on the length of her life and her success in rearing calves from birth to one year; differences in the total number of calves born are relatively unimportant. In contrast, among stags, the number of females fertilized per year is the principal determinant of breeding success, and neither the rate of calf survival nor the stag's life span is as important as among hinds.

The basic factors affecting the breeding success of males and females also differ. Among stags, access to females depends principally on fighting ability, which, in turn, depends on the animal's body size. The body size of an adult is influenced by its growth rate as a juvenile, which appears to depend on its mother's milk yield and body condition. Thus, the breeding success of a stag may be largely determined by the time it is one year old. In contrast, body size, dominance, and fighting ability have little effect on the reproductive success of hinds. Instead, a hind's success depends principally on the quality of her home range (which she inherits from her mother) and the number of relatives with which she shares it.

are greater than those of rearing females. Birth weights of male calves average a pound heavier than those of females and the gestation length of males is about two days longer. Comparisons of suckling behavior show that male calves suck longer and more frequently than female calves, suggesting that the energy costs of rearing sons are probably greater. Furthermore, rearing male calves depresses the mother's subsequent reproductive performance more than rearing females: hinds that rear a male are more likely to be barren the following year than those that rear a female. A further indication that the body condition of hinds is usually poorer after rearing a male is provided by analysis of calving dates in the subsequent year: on average, hinds calve eleven days later in a year following a breeding season when they have supported a male, as opposed to a female, calf. Studies of lactation in other animals where males are substantially larger than females also indicate that males may be more costly to produce and rear. Male caribou calves are born heavier than females, grow faster, and have a higher milk intake. In elephant seals, male pups are born heavier and grow faster than females, are weaned later, and tend to be more persistent in their attempts to obtain milk after weaning.

These differences in the factors affecting breeding success in males and females help to explain the adaptive significance of many differences between the sexes in morphology, physiology, and behavior. For example, selection has presumably favored larger body size in stags (which can weigh up to twice as much as hinds) because fighting ability has such an important influence on their breeding success. The importance of fighting to stags also helps explain why antlers, manes, and seasonal development of the neck muscles occur only among males. And it may even help us understand why, during their first two years of life, young males (among red deer and many other mammals) lay down less body fat than young females. The most likely explanation is that selection favors maximal investment by young males in growth at the expense of laying down fat reserves, which would help assure survival during times of food shortage. It is evidently a high-risk option, for yearling and two-year-old males are substantially more likely to die than females of the same age.

If early growth is more important to stags than hinds, then mothers, in order to maximize the success of their offspring, might be expected to invest more heavily in their sons than their daughters prior to weaning. In theory they might accomplish this in at least two ways. Either they could vary the sex ratio of their progeny so as to produce sons at times when they are in superior body condition and daughters when in poor condition or they might simply transfer a larger proportion of their body resources to sons than to daughters.

We found no evidence that the sex ratio of calves varies with the mother's body condition or with environmental factors, such as home-range quality, likely to affect her condition. But several lines of evidence indicate that mothers invest more heavily in their sons than their daughters and that the costs of rearing male calves

This raises the associated question of what overall proportion of sons and daughters a parent should produce. One might think that polygamous animals like red deer, where a single male can fertilize several females and only a small portion of males are able to win harems, should produce more daughters than sons. The argument is appealing because it is immediately obvious that this would represent the most economical use of resources by the population. It is, however, fallacious since natural selection does not maximize the reproductive performance of populations. The question must be restated in terms of individual advantage: What proportion of sons and daughters should an individual produce to maximize his or her own reproductive success?

Many answers have been offered. One of the earliest attempts—by the eminent eighteenth-century physician and Fellow of the Royal Society John Arbuthnott—even concluded that polygamy was unnatural because it was clearly not designed to satisfy the greatest number of individuals:

> Among innumerable Footsteps of Divine Providence to be found in the Works of Nature, there is a very remarkable one to be observed in the exact Ballance that is maintained, between the Numbers of Men and Women; and by this means it is provided, that the Species may never fail, nor perish, since every male may have its Female, and of a proportionable Age. This Equality of Males and Females is not the Effect of Chance but Divine Providence, working for a good End. . . .
>
> From hence it follows, that Polygamy is contrary to the Law of Nature and Justice, and to the Propagation of Human Race; for where Males and Females are in equal number, if one Man takes Twenty Wives, Nineteen Men must live in Celibacy, which is repugnant to the Design of Nature; nor is it probable that Twenty Women will be so well impregnated by one Man as by Twenty.

A more plausible theory was first provided in 1930 by R.A. Fisher, the great British geneticist, who argued that where the cost of producing sons and daughters was the same, the average parent should produce equal numbers of both sexes. Fisher's conclusion was based on the fact that the average reproductive success of members of each sex must be inversely related to their frequency in the population. For example, suppose an inherited trait that caused its carriers to produce an excess of females had spread throughout a population. Because the population would include a high proportion of females, the average reproductive success of individual males would exceed that of females. Consequently, selection would favor individuals that produced a higher proportion of male offspring. As male-producing types spread, their advantage would decline, and when the population contained a preponderance of males there would again be selection for types producing female-biased sex ratios. A stable situation would be reached when the average parent produced equal numbers of sons and daughters.

Undistracted by the suckling of her calf, a hind grazes, below. Male calves suckle longer and more frequently than female calves, requiring more of the mother's energy through the weaning stage. Nuzzling a member of his harem, the stag, right, is an example of a male in his breeding prime. His ability to breed successfully will probably not last more than four years.

Marion Hall

Where the costs of producing sons and daughters differ, Fisher's argument predicts that parents should divide the total resources at their disposal equally between the two sexes, producing fewer of the more costly sex. The reason for this can also be understood intuitively. Suppose a species existed in which sons cost twice as much as daughters but the sex ratio of offspring produced was equal. In these circumstances the benefit gained by a parent that produced a son would be less, per unit of resources expended, than the benefit gained by one that produced a daughter. Consequently, a type that produced daughters would be favored by selection and would spread until a situation was reached where the average parents divided their resources equally between the production of sons and daughters.

So what of red deer, for which we now have firm evidence that sons cost more to produce than daughters? At birth, the sex ratio of deer calves shows a consistent male bias: 57 percent are male. By weaning, the male advantage has fallen as a consequence of higher male mortality, but it is still about 53 percent—not the expected bias toward females.

Is Fisher's theory wrong? This seems unlikely, for its logic is compelling. The probable explanation is that the costs of breeding do not end at weaning. A hind's daughters adopt home ranges overlapping her own range, while her sons disperse between the ages of two and four to join stag groups. As the number of daughters occupying a mother's range grows, the reproductive success of all members of the matrilineal group falls. In other words, there are costs associated with producing daughters that extend over the rest of the mother's life span. We are not yet able to measure them precisely, but it would not be surprising if they proved to be as great or even greater than the increased costs of rearing sons in the first year.

Our study is not yet complete, and we are only beginning to establish the factors responsible for individual differences in lifetime reproductive success. But we have already shown how important it is that studies of long-lived animals be of adequate duration. None of the results I have described could have been achieved within a two-year period—the usual span of most field studies. Only by observing animals throughout their lives are we likely to gain a true understanding of the influences on breeding success, and thus of the workings of natural selection. And only by regarding males and females as if they were two different species are we likely to understand why it is that the sexes differ so widely in anatomy, physiology, and behavior. ☐

Tim Clutton-Brock

Blanket bog in the Cambrian Mountains, Wales
Paul Wakefield, Bruce Coleman

Beneath the Blanket Bogs of Britain

Thousands of years ago, bogs replaced many of Britain's forests. Prehistoric peoples and a deteriorating climate were responsible

by Peter D. Moore

In the year 1538, during the reign of King Henry VIII, John Leland, the king's antiquary and library keeper, undertook a journey around Britain that led him across the hills of Cardiganshire, an old county of central Wales. The words he used to describe the desolate, peat-covered slopes convey something of the boggy, unwelcoming, mist-shrouded landscape that met his eyes: "The pastures of the montaynes of Cairdiganshire be so great that a hunderith part of hit rotteth on the ground and makes sogges and quikke more [mires] by long continuance for lak of eting of hit."

Evidently, what impressed John Leland most about the area was the blanket of wet, peaty material that covers the hills, plateaus, gentle slopes, and valleys of this region. The wetlands are still a distinctive feature of the Welsh uplands, and because of their extensive spread and apparent independence of topography, they have been given the name "blanket bogs."

Many mires (a general term covering all peat-forming wetlands) are restricted to valleys and basins where they are supplied with water that drains from surrounding catchments; these include fens, swamps, and valley mires. Some mires build up so much peat that their surface is elevated out of reach of the drainage waters; these are the raised, or domed, bogs of western Europe. Only the blanket bogs, however, begin their growth over hilltops and slopes, thus becoming totally dependent on rain as a water supply from an early stage in their development.

The keen, observant eye and analytical mind of John Leland, coupled perhaps with an acute sense of economics, is reflected in his brief description of these blanket bogs. He realized immediately that the accumulation of these peats must have resulted from a production of plant material at a faster rate than the local herds of sheep and cattle could consume it. Hence "for lak of eting of hit," the vegetation lay rotting upon the ground—a sad waste of good fodder. In one respect he was right in his analysis of the causes of blanket bog formation, for plant production must exceed animal consumption if peat is to build up, but he was not entirely correct in his emphasis on decay. If decay processes—the breakdown of organic matter by fungi and bacteria—were taking place in a healthy manner, then no peat would be present. It is the very impairment of decay, mainly by waterlogging and low temperature, that results in the accumulation of undecomposed vegetable matter over the landscape and the rise of the "sogges and quikke more" Leland described.

Since blanket bogs are situated on hilltops, where water tends not to accumulate, very high rainfall is necessary before waterlogging and peat formation can occur. When hilltop soils do become saturated with water, oxygen no longer penetrates freely, as it does in well-aerated soil. Consequently, plant roots and soil animals, bacteria, and fungi have to cope with a limited oxygen supply, which leads to the elimination of many species. The microbes that remain in the soil operate at a generally reduced rate, so that decay processes slow down and peat begins to build up.

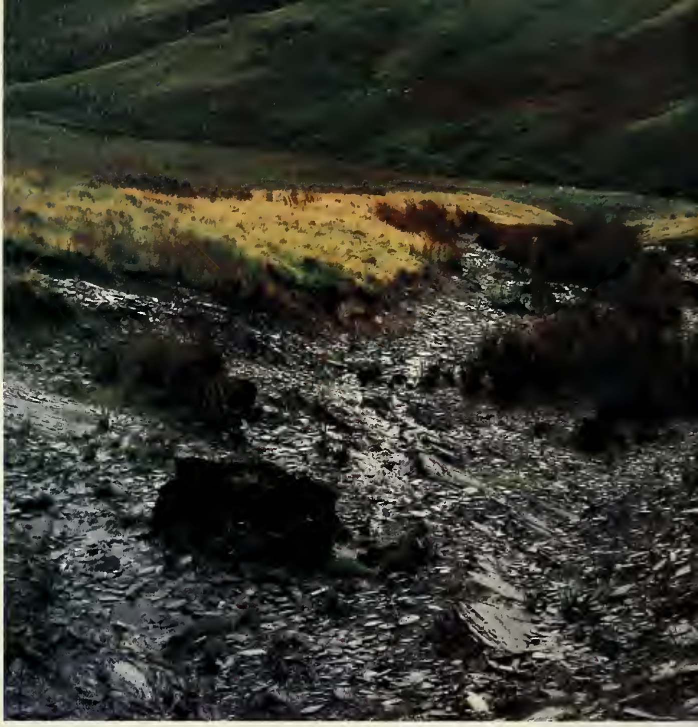
The peat blanket that develops is often unstable because of sloping topography, and it is frequently dissected by deep erosion gullies, which expose the dark peat mass beneath the superficial skin of vegetation. Sometimes, usually after prolonged, heavy rain, the peat mass becomes fluid and mobile beneath the surface crust, and the peat cover of an entire hillside may burst free and flow down into the valleys below.

Where bog bursts have taken place or where erosion has cut back to the underlying soil or rock, examination of an entire profile of blanket bog is possible. Within the succeeding layers of peat, the blanket bog has left a chronicle of its own development. Passing down through the compressed, fibrous masses of peat is a trip back in time, and when the fragments of plant matter in the peat are identified, a mental image of the vegetation of long ago can be reconstructed. Perhaps most interesting of all, the bottommost layers of the peat mass, sometimes nine or more feet down, provide clues about the changes that led to the development of the blanket bogs in the first place. Here, at the junction of the gelatinous, black basal peat and the ancient soil surface, pieces of wood often turn up, and sometimes even whole branches or trunks of trees are found. Were these hills once forested? And if so, what caused the destruction of the hill woodlands and their replacement by the boggy landscape of low agricultural potential that now prevails?

In the hope of answering such questions, I began work in 1963 on the botanical analysis of the blanket bogs of Wales. I have been joined by other ecologists, many of them my students, who are also seeking to unravel the buried secrets of the blanket bogs. Over the years, we have been able to piece together an increasingly detailed and full reconstruction of this transformation of the ancient Welsh landscape.

The development of blanket bogs has generally been ascribed to climatic changes that led to the cool, wet, oceanic conditions now found in the Welsh mountains. Climate is obviously an important factor in the development of the bogs since the necessary waterlogging requires low evaporation, brought about by low temperature, and high rainfall. The blanket bogs of Europe are geographically re-

Blanket bogs usually originate on hilltops and slopes. Sometimes, particularly after heavy rains, the peat mass beneath the crust of a hilltop bog becomes fluid and bursts free, gouging out a channel to the valley below.
Peter D. Moore



stricted to regions of oceanic climate, being found mainly in the British Isles, particularly in northern and western parts, and in western Norway. In Wales, they are rarely found below an altitude of about 1,400 feet, but in cooler, wetter regions, such as western Ireland and western Scotland, they may develop right down to sea level. Clearly, climate is important, but was it the only factor operative when the bogs began to spread?

Microscopic examination of the basal layers of peat often reveals the presence of charcoal fragments, so evidently the early bog communities were subjected to burning. Might these fires have been caused by lightning strikes or might they have been induced by humans—some primitive form of land management? And what role might these fires have played in bog formation? The answers to such questions were sought in the pollen contained within the peat bogs.

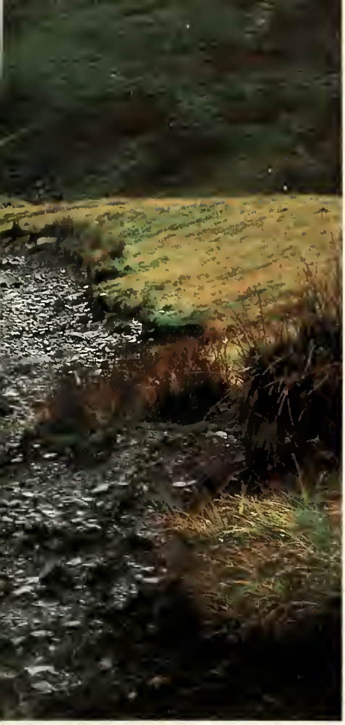
Pollen grains are shed into the atmosphere in large quantities, especially by plant species that rely on wind for pollination, such as grasses, sedges, and many trees. Very few of the pollen grains released from the male reproductive organ, the stamen, actually find their way to a receptive female organ, the stigma, of the correct species. By far the majority fall on sterile ground, and most of these decay. Any that happen to be deposited upon a wet, growing peat surface, however, may be preserved in the peat. The outer coat of a pollen grain has a characteristic pattern of pores and grooves and may also be sculptured in a distinctive way. Resistant to decay, this coat enables us to recognize major tree types and other groups of plants, such as grasses, and in some cases makes it possible to identify plants down to the level of species—heather, for example. The use of pollen as a clue to past vegetation has certain advantages over the examination of the larger plant fragments preserved in the peat: since pollen is transported over some distance and is mixed up in the atmosphere, it reflects the composition of vegetation over a wider area than that represented by twigs, leaves, and fruits. Unfortunately, plants that have poor pollen productivity or poor dispersal (often insect-pollinated types) are underrepresented in the record.

From the start, pollen analyses of blanket bog peats revealed that some interesting vegetation changes were taking place when the peats began to form. The base of the first three blanket peat sites I examined showed a marked and abrupt decline in elm pollen and a concurrent rise in the pollen of ribwort plantain, a herbaceous weed found in disturbed grassy areas. The elm decline has been recognized in pollen analyses across northwestern Europe, and where dating by radiocarbon or other techniques has been possible, the event has been dated at about 3000 B.C. The consistency of the timing for various sites (most dates fall between about 3200 and 2800 B.C.) enabled me to assert that the blanket peats at the three sites I studied began their formation at about the same time.

But does this pollen evidence imply anything about the possible causes of peat formation? A look into the causes of the elm decline itself may help answer this question. The suggestion has been made that the climate may have become suddenly colder, leading to the death of elms. Some elm species, however, are still able to grow and set seed in northwestern Britain, so climate is unlikely to have been a limiting factor. Another proposal is that since elms prefer rich soils, perhaps the decline resulted from soil deterioration as the nutrients were leached away under heavy rainfall conditions. But soil deterioration is unlikely to have been abrupt in its effects and so could not account for the uniform timing of the elm decline over a wide area.

Elm disease, similar to that now rampant in Britain, could have been a causative agent, although this is difficult to prove in the absence of direct, fungal spore evidence. Furthermore, the disease hypothesis cannot explain some of the associated changes in the pollen record at the time of the elm decline: a reduction in the pollen of the lime tree (another species that could have been used as fodder), an increase in the pollen of various weed species (which often colonize disturbed sites), and significantly, the occurrence of some cultivated plant pollen, such as cereals.

As long as forty years ago, consideration of these changes led the Danish scientist Johs Iversen to suggest that humans were involved in the episode. Five thousand years ago, during the Neolithic period, or New Stone Age, agriculture and the domestication of animals spread from the Middle East across Europe. Perhaps the basal layers of blanket bogs are a



Erosion may expose the lower layers of a bog and may even cut down to the underlying soil or rock. Pieces of wood, such as this ancient pine stump, often turn up, suggesting that the landscape was once forested. Other evidence, including pollen analysis of the peat, indicates that the agricultural activities of prehistoric peoples may have caused the destruction of the woodlands and contributed to their replacement by bogs.

Peter D. Moore

record of the first instances of agricultural activity in the British Isles.

Elm twigs and bark are known to be highly nutritious and are greatly favored by browsing animals. Indeed, until very recently, an elm-bark bread suitable for human consumption was manufactured in Scandinavia, especially during times of food scarcity. In the Neolithic, elm twigs and branches may have been cut and stored for winter fodder; perhaps cattle were stalled for much of the year and fed in this way. The practice of lopping trees for fodder can still be seen in rural parts of Switzerland and Austria and in the Himalaya foothills of India, where it has a devastating effect upon the forests.

Could the development of farming among a primitive, prehistoric people have resulted in environmental changes so profound that the upland woods were doomed and the spreading of the bogs began? The direct results of agriculture would have included the removal of some trees in order to cultivate soils, but this would have occurred mainly in the rich, alluvial valley soils, not on the upland plateaus where the blanket bogs formed. On the plateaus, grazing goats, sheep, pigs, and cattle would have reduced the survival rate of young trees and may well have caused the death of older ones by stripping off bark. Added to this, fire may have become a popular technique for encouraging coarse grasses, leading to the development of open moorland. This would account for the charcoal fragments in the basal peat.

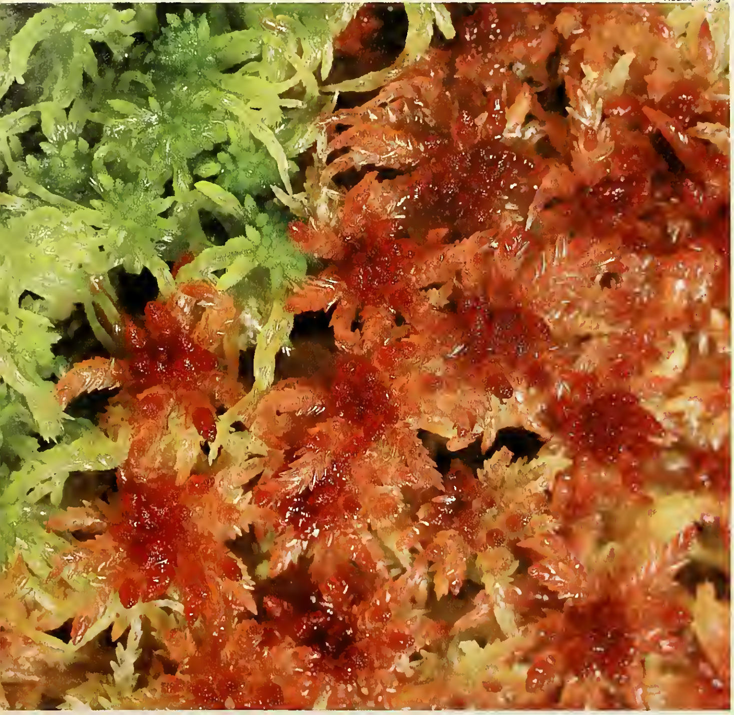
But this still does not explain the waterlogging, which, as John Leland recognized, is such a distinctive feature of the area. There are two ways in which forest clearance could have led to wetter soils. In the first place, the loss of a tree is like losing a water pump and an umbrella combined. A tree is constantly removing water from the soil and losing it to the atmosphere through its leaves. This pumping process, termed transpiration, has a drying effect upon the soil. The tree acts as an umbrella in that its canopy intercepts rainfall, much of which will evaporate from the leaves and twigs without ever reaching the soil. If the tree is taken away, the soil becomes wetter, which, in turn, may make it more difficult for the next generation of tree seedlings to establish themselves, especially under heavy grazing pressure. Modern forest-clearance experiments in Europe and the United States show that water draining through the soil can increase by as much as 40 percent after forest removal.

A second effect of forest clearance concerns the development of the soil. The removal of trees from nutrient-poor, acid upland soil leads to the invasion of moorland plant species, such as cotton sedge, heather, cross-leaved heath, and perhaps most influential of all, the bog moss sphagnum. All of these have a marked effect upon the soils beneath them, for the litter they produce is rich in chemicals called polyphenols. As these compounds pass down the soil profile, clays dissociate; their iron and aluminum components leach out in an oxidized form and are usually redeposited in a hard, concreted mass, or hardpan, about eight to twelve inches down in the soil profile. This process, called podzolization, modifies the drainage properties of the soil. Water collects above the pan, and waterlogged soils and peat accumulation may result.

To test whether forest clearance and agricultural activities might have been responsible for the development of blanket bogs, I needed to determine the precise sequence of changes involved in the destruction of the woodland. A suitable site was found near a series of Neolithic tombs at a place called Carneddau Hengwm in North Wales. At the base of this blanket peat site was a layer of wood, consisting mainly of alder and willow, which was superseded by bog mosses as the bog com-

The close-up below shows two species of sphagnum, or peat moss, which ranges in color from pale green to deep red. Perhaps the most influential plant in the formation of blanket bogs, sphagnum has a high capacity to hold water and a slow decomposition rate. It also traps waterborne nutrients, preventing them from reaching other plants. Once sphagnum is established, it may share the wetland with rushes or moor grass, as in the blanket bog in Dartmoor, England, right, but no tree can survive in the waterlogged soils.

Heather Angel



munities replaced the woodland. Having collected a complete core of these basal layers, I sliced the peat into adjacent samples just 0.5 cm thick and extracted their pollen. The pattern that emerged from the analysis is not a gradual changeover from forest types to boggy species, but a series of episodes during which there are signs of disturbance followed by periods of partial recovery.

The early disturbance phases probably indicate occasional use of the woodland by prehistoric peoples and their flocks. As long as only a few trees were removed for fuel or building purposes and as long as the grazing pressure was fairly light, the clearings and glades thus produced would have regrown almost completely. As land use became more intense, there was a stepwise destruction of the forest until, finally, an environmental threshold was crossed and recovery of forest became impossible.

The crossing of the threshold may well have been marked by the invasion of sphagnum into the degenerating, wet woodland, and its assumption of a dominant position in the vegetation. In addition to the polyphenols it produces, this plant profoundly influences its immediate surroundings by creating its own microhabitat around its hummocks. Having invaded the damp ground surface, it grows to form cushions with a high capacity for holding water, mainly because most of the sphagnum leaf consists of large, dead cells with pores that fill with water. In this way, sphagnum increases the water retention of the surface of the soil, but its effect does not stop there, for its cell walls are able to trap the nutrient elements present in the water and thus prevent them from circulating and becoming available to other plants. Furthermore, because wet sphagnum moss decomposes slowly, peat builds up, insulating the bog surface from underlying soil nutrients. With the establishment of the bog mosses, the woodland's fate was sealed.

Detailed pollen analyses, combined with a knowledge of how bogs form, suggest a clear picture of the way in which prehistoric people assisted in the destruction of woodland in these wet, marginal upland areas and eventually provided the bog mosses with an opportunity to assume complete dominance of the terrain. For some while, however, it was difficult, using the carbon-14 technique of dating, to obtain independent confirmation that the age of the basal layers of blanket bogs matched the age of the elm decline. Blanket bogs contain some plants with deep

roots, which may even penetrate three feet or more of bog and enter the buried soils below. The carbon-14 method depends upon getting a sample of organic matter from the required layer without any contamination by younger material, so these younger roots interfere with accurate dating of the bog base. Fortunately, Alan Smith, while at the Palaeoecology Laboratory of Queen's University in Belfast, Northern Ireland, developed a technique in which the fine material (largely pollen grains, spores, and fungal debris) is extracted in bulk from samples of peat so that the dating can then be carried out. This reduces considerably the dangers of contamination and has provided some reliable dates for the basal parts of the blanket bogs.

The dates obtained from Wales and the southwest of Britain initially seemed to confirm the suspected Neolithic origin of many of the deeper, plateau blanket bogs. My students David Merrifield and Miles Price, for example, established dates older than 2200 B.C. for the high-level bogs of Exmoor, a hilly region in southwest England, and 2800 B.C. for some bogs in Wales. This strengthened my belief that Neolithic culture and land use had indeed exerted a strong influence upon the shift from forest to bog.

But things were evidently not that simple. David Merrifield found that some of the shallower peats on Exmoor were formed more recently, probably in Iron Age times, that is, the first millennium B.C. At the same time, Smith and his students found that the blanket peats in Northern Ireland and in parts of South Wales began forming at a variety of times, but most frequently about 2000 to 500 B.C., in the Bronze and early Iron ages. To complete the confusion, some of the blanket peats from the Pennine Range, the backbone mountain chain of northern England, were among the oldest recorded, many going back to 5000 B.C. This new information does not mean that prehistoric humans were blameless in the changes taking place, just that the blame cannot be placed entirely upon one cultural group. In all of the areas listed here, there is ample evidence of human activity in the basal layers of the peat, and this is the critical feature to look for.

Archeology is providing some additional clues to the development of blanket bogs. For example, the excavations of Geoffrey Dimbleby and Frank Mitchell in Ireland have revealed the scars left by Neolithic "plowing" in the soil beneath the blanket peats. They suggest that the primitive implements of the Stone Age people were able to turn only the superficial layers of soil and that this contributed to the development of an impermeable layer immediately below the plowed horizon. Tillage of this sort would have impeded drainage and led to soil waterlogging and, ultimately, to bog formation.

The very early development of blanket bogs in the Pennines in the north of England remains something of a mystery. One important consideration is that this area supported relatively large populations of Mesolithic (Middle Stone Age) people. Although these cultures were not strictly agricultural in the sense that they cultivated crops, they may well have managed red deer, wild cattle, or other game animals to some degree, and this could have led them to burn and clear woodland in order to increase game populations. More evidence is needed about land management by early prehistoric cultures, but the possibility of environmental changes caused by humans in preagricultural times should certainly not be discounted.

One further question that needs to be raised concerns population density. Just how many prehistoric people had to live in an area to provide a sufficient work force to remove forest and keep it clear? In 1953, some Danish ecologists conducted an experiment to determine how effective the Neolithic polished axes would be at felling areas of forest. Borrowing some ax heads from the National Museum of Copenhagen, they set to work in the Draved Forest of south Jutland. After some practice, they found that they could fell an area of 600 square yards in four hours. Larger trees could be killed by cutting around the bark and allowing them to die; they could be removed more easily after a few years of rotting. The use of fire was found to be helpful, both in the removal of dead scrub and in the fertilization of soils. The experimental wheat crops grown in the Danish clearings were quite successful immediately after clearance, but productivity declined after three years as the nutrients were leached away. Such experiments demonstrate that a relatively small population of people could have had a profound influence upon their environment over a wide area. Their influence would have been greatly increased by herds of grazing domestic stock, such as cattle, sheep, pigs, and perhaps most significantly, goats.

In all of this, humans must be thought of as tipping the scales in an already delicately balanced environment. Under the oceanic climate of northwestern Europe, with very high rainfall and low summer temperatures, temperate deciduous woodland was already close to its tolerance limits. The forest is likely to have been low in stature and open in structure, regenerating poorly and vulnerable to disturbance. Most sensitive of all would have been the regions of highest rainfall—generally the northern uplands—and the areas of poor drainage—the flat plateaus. These are the locations in which the oldest blanket mires began their formation. From 5,000 years ago onward, the climate was probably becoming cooler and wetter, but this process is difficult to analyze in detail. A deteriorating climate would have encouraged bog spread and made surviving upland woodlands even more sensitive to the impact of human cultures. So, by Bronze Age and Iron Age times, even some of the better-drained regions—the sloping hillsides and lower-altitude hilltops—began to accumulate blanket peat as the forest retreated before the onslaught of humans under what, for the existing vegetation, were already marginal conditions.

Many in modern society decry, with some justification, the current capricious and wasteful misuse of land, undertaken with little concern for long-term environmental consequences. Some of these modern objectors point back to the time of our rural forebears as a golden age, as though preindustrialized agriculture were conducted in a manner that exhibited a greater care for the environment. The lesson of the blanket bogs is a different one. It demonstrates that from the earliest agricultural and even preagricultural days, people have rarely planned beyond immediate and obvious economic gain. As far as the spread of the bogs was concerned, they had some excuse, for they could not read the fossil record. We have none, for we can. □

This stretch of blanket bog, shallow on the slopes (foreground) and deeper in the valley, is in the Hebrides, off the west coast of Scotland. European blanket bogs are restricted to regions of oceanic climate, especially the western and northern parts of the British Isles, because the waterlogged conditions necessary for their development require high rainfall and cool temperatures.

Dennis Green; Bruce Coleman

Bird in a Cave

White-collared swifts nest in caves inaccessible to most predators. Their wing structure, gregariousness, and feeding habits enable them to exploit such safe havens for rearing young

by David Whitacre and Devora Ukrain

photographs by Gene Groeschel

Seen from the vantage point of a canyon rim, white-collared swifts darting through waterfalls are a sight to behold. The birds seem to defy the crush of falling water. They are doing no such thing, of course; they are actually diving between gaps in the sheets of water so that they can reach the nests they have constructed in fissures and grottoes in the rock wall behind the waterfall. Why swifts choose nest sites with such difficult access, and what adaptations are needed to utilize the sites, were questions we hoped to answer through a field study we conducted at several swift colonies in Mexico. Our findings are that such nesting habits are related to the swifts' feeding habits and morphological adaptations for flight.

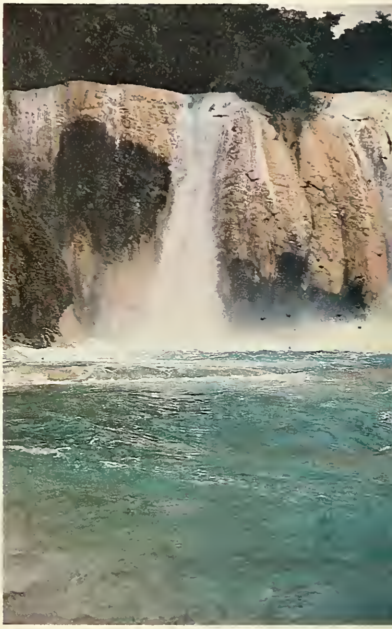
The most widely distributed of the New World swifts, the white-collared occupies mountainous regions from east-central Mexico to northern Argentina. With a wingspan equal to that of a mourning dove and a weight of nearly one-fourth of a pound, it is one of the larger swifts. Most of the world's seventy species of swifts are black or brown, often with white markings on the face, breast, or rump. Thus, the white-collared swift's black plumage and white collar are not remarkable among swifts; neither is its distribution, as the tropics are home to the lion's share of swift species.

White-collared swifts build their shallow-cupped nests of moss, ferns, and bits of rock on narrow ledges in grottoes behind waterfalls and in deep, cisternlike pit caves, carved into limestone bedrock by groundwater solution. Strange as such nest sites may seem, they are not unusual for swifts; as a group these birds seem to specialize in bizarre nest sites. For example, the small edible-nest swiftlet of Indo-Malaysia constructs its nest entirely of its own saliva, gluing it to the vertical wall of a cave. These nests are an ingredient of bird's nest soup, and they provide an important industry for intrepid local people who climb makeshift scaffolds to scrape them from cave walls by the thousands each year. Many other species use saliva to a lesser extent to glue together nesting material, such as twigs, feathers, or fluffy seeds. In contrast, the large white-naped swift of southwestern Mexico makes no nest at all, simply laying its one- or two-egg clutch in a slight depression on a sandy ledge in a cave. One large genus of swifts, including the chimney swift, glues its twig nests to the inner walls of chimneys or hollow trees. And the white-collared swift is not the only swift to nest behind waterfalls; several species share this habit. These diverse nest sites are all basically inaccessible to most predators.

What kinds of birds are able to exploit a cave for nesting? Singly or in small numbers, almost any species might nest there. A variety of flycatchers, hummingbirds, wrens, thrushes, and even birds of prey share some of our study caves with white-collared swifts. All of these birds hold territories that include their nests and an adjacent area in which they find food. But only birds that nest in dense aggregations can fully exploit the potential of cave nesting; such nesting behavior requires a foraging strategy not dependent on local food sources since a shortage would quickly result. The bird must be a species that gathers its food over a large area.

The dispersion of available food sources is probably a powerful influence determining whether a species will hold individual territories or roost and forage in large aggregations. If food is sufficiently dense and predictable to be economically defensible, territoriality and dispersed nesting will result. In contrast, birds relying on food that occurs unpredictably or is thinly distributed cannot defend such resources for their exclusive use. Instead, they can nest and roost colonially and range outward to feed in flocks. Such is the case with these swifts.

What are the traits that fit swifts for their specialized life style? Swifts and hummingbirds are classified in the same taxonomic order. Among the major similarities that have led ornithologists to the conclusion that these two dissimilar groups have a common ancestry is their peculiar wing structure. In both swifts and hummingbirds, the bones corresponding to those of human hands are proportionately large and tightly jointed, to support the long, stiff primary feathers that result in the rigid, bladelike wing of both groups.



Above: One of the numerous cascades on the Rio Yaxjá, near the village of Agua Azul in southern Mexico. Thousands of white-collared swifts nest in caves and fissures hidden by the powerful curtains of water. Facing page: A white-collared swift adopts a hovering form of flight while waiting for a gap to appear in a waterfall. At the opportune moment, it will shoot through to reach its nest behind the falling water.

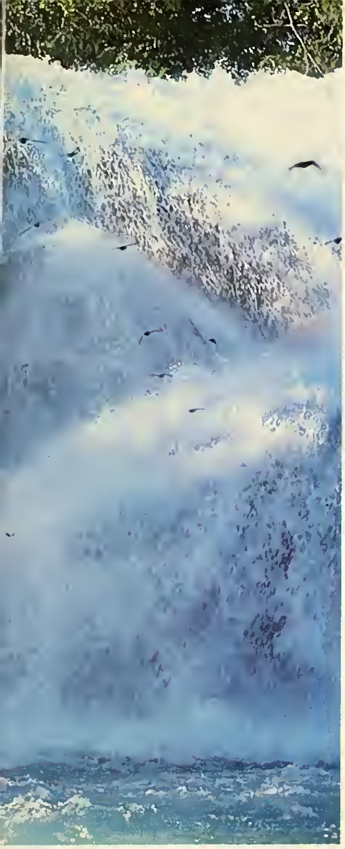
The radius and ulna of the lower arm are shortened compared to those of other birds, and the humerus of the upper arm is extremely shortened and thickened. The result of these proportions is a wing that is long for the body size of the bird, but due to its concentration of skeletal and musculature mass near the body, very rapid wingbeats are possible. Combined with these features are a shoulder joint allowing an unusual degree of wing rotation, a greater proportion of muscle used in the upstroke than that found in most birds, and unusually robust attachments of these muscles to the humerus.

The net effect of these structural features is well known for hummingbirds; the rapid wingbeats and ability to generate substantial lift on the upstroke provide the hovering ability that permits this lineage of birds to exploit the insect fauna and sugary nectar of flowers, for which they have few avian competitors. The ramifications of these adaptations are less well known for swifts. Although it has not been generally recognized, we believe that hovering ability, while not used in feeding, may be as important to swifts as it is to hummingbirds.

Our first observations of white-collared swifts were conducted at the mouths of pit caves in east-central Mexico, where we estimated populations and studied the behavior of swifts during their dramatic morning exit and evening entrance flights. We came to know these birds as superlative fliers, capable of high-speed flapping or gliding flight. Thus, upon entering their dark nesting and roosting caverns, we were surprised to learn that in this underground world the white-collared swift is a different bird. The swifts attain impressive speeds as they dive into a cave or waterfall, but as they penetrate the darkness, they apply the brakes, whiffling from side to side to bleed off speed. They proceed haltingly—their bodies in a near-vertical position, their wings beating rapidly—until they find a vacant roosting spot on the cave wall or arrive at their nest. When changing perches within the cave, swifts use the same semihovering flight, moving forward slowly, their wings beating perhaps as rapidly as those of some large hummingbirds.

White-collared swifts must rely on their large eyes to gather light for navigation in dimly lit chambers. But they could scarcely nest in such places without the ability to fly very slowly, in a near-hovering mode. Certainly, the high speeds they exhibit in flight outside the caves would be fatal in these dark, rocky confines. Thus, we hypothesize that at least for white-collared swifts, and possibly for the entire swift lineage, the ability to hover has permitted the exploitation of specialized nest sites that allow them to minimize predation risk to their eggs and nestlings.

Why is the use of such specialized nest sites a trait shared by all swifts? In general, organisms either saturate their environment with eggs, few of which will survive to maturity, or they provide a small number of eggs or young with some security from predation and the elements. All birds are in the latter category, but because of their feeding habits, swifts may



Virtually safe from predators while in the open air, swifts are preyed on by hawks when entering and leaving their nest sites. At times, a hovering swift must wait so long for the chance to fly through a waterfall that it becomes exhausted. Such birds, below, can be seen clinging precariously to rocks, resting until they can again attempt to reach their nests.

be under especially strong selection pressure to minimize nesting mortality.

Although swifts have a tiny, dovelike beak, it is attached to a mouth capable of a large gape, increasing the target area for scooping up insects in flight. It is a safe bet, however, that these birds are not merely flying vacuum cleaners, taking anything they encounter in their wide-ranging foraging flight. Studies of a variety of swifts and swallows have shown that they do not take a random set of those insects available to them. Rather, they show some selectivity, with prey size and flight speed playing an important role in determining what is taken.

White-collared swifts often feed heavily on mating flights of winged termites, which emerge by the thousands after the first showers of the rainy season. Although this food source is predictable in the sense that it can be expected at the onset of the rainy season each year, when white-collared swifts are feeding their young, it may be unpredictable on a local, daily scale because termite colonies are scattered and do not all swarm at the same time. Adult swifts have to fly a long way in order to glean enough food to merit a trip home with their throats crammed with food for the nestlings. At times nestlings in our study colony were fed only once in twenty-four hours; consequently, they grow slowly. Their parents probably cannot supply them with enough food to permit more rapid growth. The period from hatching to fledging for a white-collared swift is about forty-five days, whereas most songbirds have a nestling period of only twelve to twenty-four days.

Because the availability of flying insects declines during cold, stormy weather, birds that feed on them, such as swifts, experience a food shortage during these periods. Weights of nestling white-collared and other swifts drop during poor weather, and some starve to death. As a means of surviving prey scarcity during bad weather, several species of swifts, including at least one tropical species, are able to lower their body temperature and metabolic rate, passing into a state of torpor. Nestlings of the common swift of Europe can survive a ten-day fast, although they may lose half their body weight in the process. White-throated swifts in the southwestern United States may routinely spend portions of the winter in a torpid state, emerging from their roost crevices to feed during periods of warm weather.

People who are accustomed to thinking of the tropics as a land of constant, predictable weather may wonder how such a fasting ability could profit a bird there. In reality, tropical environs are subjected to substantial variation, especially in the timing and quantity of rainfall. Our east-central Mexico study area is frequently subjected to *nortes*, or "northers," which are cold air masses that push south down the gulf coast of Texas and Mexico, causing periods of two to five days of chilly, rainy weather. Although we do not know if white-collared swifts become torpid, they are evidently able to fast to some extent. On one extremely foggy day, a population of 25,000 swifts did not emerge to forage all day.

Swifts are often thought of as high-speed specialists and not as gliders, but white-collared swifts spend much of the day on the wing in gliding flight. At times they intersperse short gliding periods with bursts of quick wingbeats. At other times, they go several minutes without a power stroke, making slight adjustments of wing position for steering purposes. Circumstantial evidence strongly suggests that the birds' use of rising thermals and updrafts created by winds striking mountainsides permits such energy-conserving flight. At some colonies, swifts returning to the cave in the afternoon and evening can be seen in huge milling vortexes, or "kettles," of a few thousand swifts, often in company with turkey vultures, moving

Below: White-collared swifts build their nests of moss on ledges in caves. Because of the relative inaccessibility of such sites, the young birds are safe from most predators. Facing page: The swifts also use caves that are not behind waterfalls for nesting and roosting. A combination of social behavior, feeding strategy, and specialized but versatile flight capabilities enables them to make use of caves and waterfalls.

slowly along ridge lines. Gaining altitude in one such vortex, they spill out in linear flight, to circulate upward again at another point along a ridge. At a waterfall colony in a narrow canyon, swifts habitually milled in flocks over one canyon wall during north winds, and over a different slope during south winds.

At times, however, speed is evidently more important than energy conservation. Swifts en route to feeding areas in the morning, and usually while returning to the colony or moving between feeding areas during the day, flew directly, with constant wingbeats. While actively feeding, swifts often used such constant flapping.

White-collared swifts excel most dramatically at diving flight. A diving white-collared swift holds its wings rigidly in a cupped position, angled slightly below the horizontal. Steering during a dive is accomplished primarily by the bird spinning on its longitudinal axis. Imagine, for example, a waterfall spilling from one side of a straight, narrow canyon several hundred feet deep. A swift approaches across the plateau from above and behind the falls, moving toward the defile at a right angle. Clearing the near-canyon rim at the brink of the falls, the swift sets its wings as it shoots down toward the opposite canyon wall. It spins, presenting its belly to the opposite wall, and executes a grand inside loop, shooting up into a dark overhang near the base of the falls.

Although the nests themselves are relatively safe from predation, the adult white-collared swifts at some colonies run a gantlet of predators each time they enter or leave the colony. For the most part, the only predators fast enough to catch them are the bat falcon, peregrine, and orange-breasted falcon. All three of these falcons eat white-collared swifts at least occasionally, but the swifts are difficult for them to capture in the open and all but impossible to capture in level flight. The story is different, however, if the falcon can dive from above, and where the flight patterns of the swifts are confined and predictable, as in the immediate vicinity of swift nesting colonies. Any aggregation of organisms is likely to attract some predators, and swift colonies are no exception. We have seen bat falcons and peregrines regularly appear, as if on cue, to pluck individual birds from the dense stream of swifts leaving a cave in the morning. Other raptors, including collared forest falcons, Cooper's hawks, and gray hawks also loiter in the vicinity of swift colonies and probably take an occasional swift.

White-collared swifts use another flight mode, a flapping, zigzagging flight, while spilling out of a cave in the morning. In this flight mode, the birds flap constantly and periodically tilt from side to side, changing course slightly with each tilt. The result is a chaotic stream of birds moving at an estimated fifty to sixty miles per hour, independently zigzagging at different rates. The swifts revert to straight-line flapping or gliding flight several hundred feet from the cave mouth. Such a "submarine evasion course," which is routinely used by swifts leaving a cave, has not, to our knowledge, been described before for birds in flocks. This erratic flight course would make them a very difficult target and thus greatly decrease their vulnerability to attack by a predator such as the falcon, diving from above.

If a flock of white-collared swifts is attacked by a peregrine away from the cave mouth, the birds bunch tightly together into a dense flock and climb into the sky. Such cohesive flocking is possible in the open sky, but not in leaving the rock-bound cave mouth, especially since the swifts exit not in a compact group, but in a steady stream over a thirty-minute period. Thus, natural selection has favored an unpredictable exit flight path for each individual. Swifts entering a cave in the evening run a smaller predation risk, since they can plummet down the throat of the pit in groups, at speeds that render them a tough catch for even an experienced falcon.

In addition to birds of prey, there are other hazards for white-collared swifts during the evening entry flight. In early evening, with ample daylight remaining, the swifts tend to form a rotating dough-nut-shaped flock above the falls or cave entrance. Birds returning from foraging may circle for a while in this reservoir of birds before joining a group of a few to a hundred or more that dive toward their nest site. In one instance, we saw two swifts collide in mid-air. Both fell, probably stunned or dead. As dusk falls, the circling mob of swifts disappears, and newly arriving birds dive straight into the cave. At such times, we have seen swifts collide with vegetation hanging in the cave mouth, but these collisions did not prove fatal.

Although the common swift of Europe is known to spend summer nights aloft, and biologist William Beebe noted that white-collared swifts flew into his lighted laboratory windows during stormy nights, the late-entering swifts we observed seemed in a hurry to get to their night roosts. We have wondered whether the hazards of movement through the darkness of their nesting sites might in time produce a bird that, like the cave swiftlets of Malaysia, is mainly a daytime forager, but uses echolocation to navigate in its dark nesting chambers. ☐

Los Ambulantes

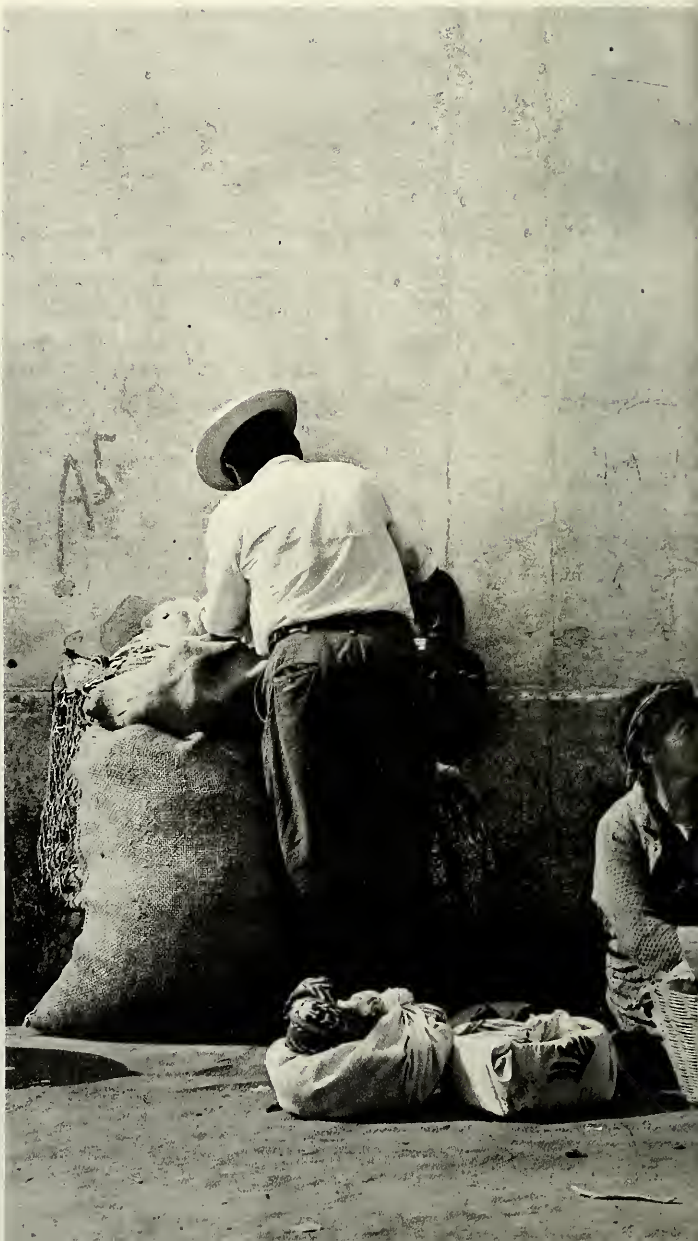
Folk tradition and a basic need for their services keep the itinerant photographers of Guatemala flourishing

Photographs by Ann Parker
Text by Avon Neal

There still exists in many Latin American countries a picture-making tradition that reaches back to the earliest days of photography. The guardians of this colorful folk tradition are the itinerant photographers who follow secular and religious fairs from village to village, photographing people who might otherwise never face a camera. These men work in the old-fashioned manner of their predecessors, using much the same basic equipment that traveling photographers have relied upon for generations: a simple, portable combination of view camera and darkroom, a plain wooden tripod, a painted backdrop, and a few standard props. Their fees are modest, and the photographs they take may fulfill an emotional desire or an official necessity.

In most countries itinerant photographers have already disappeared. Better transportation, modern photographic techniques, and inexpensive cameras have greatly diminished their ranks. Of the hundreds who once roamed the dusty byroads of Mexico and Central America only a few score now practice as true itinerants; most have become studio or park photographers. Guatemala, where there is still a functional need for itinerants, is a notable exception. How long this tradition will continue, however, depends largely upon the future economics of rural and village life. Relatively affluent people can buy simple cameras and take their own snapshots, and for formal occasions they can afford the services of commercial studios.

Following a picture-making tradition that closely parallels the work of North America's early limners, who in their time created a whole new genre of folk painting, the itinerant photographers of Guatemala are simply reproducing in a different medium the images of people who, for vanity or for other, more practical reasons, want pictures of themselves or their loved ones. Customarily, photographers visit out-of-the-way places during saints' days



Excerpted from *Los Ambulantes: The Itinerant Photographers of Guatemala*, by Ann Parker and Avon Neal, by permission of The MIT Press, Cambridge, Massachusetts. ©1982 by The Massachusetts Institute of Technology. Photographs © Ann Parker.

JAMAS TE OLVIDARE

and national holidays. (They are less active at Easter, when people spend their money on candles and other religious articles and when many photographers who are also farmers are likely to be at home planting.) Along with their cameras and their flamboyant props, the *fotógrafos ambulantes* bring an air of mystery and romance. Most women come to the celebrations wearing the colorful costumes of their villages. The men, when not in native costume, usually wear dark suits and straw hats. A carnival atmosphere prevails, and money is spent with reckless abandon. This is the time to celebrate the past year's beneficence or to mourn its misfortunes, to purge one's soul and begin anew. Besides the traditional religious festivities there is much trading, buying and selling, general mixing, and matchmaking. In the evenings there is music, dancing, and drinking. It has become customary for celebrants to have their pictures taken as mementos. For about an average day's pay they can pose in front of a painted backdrop and be instantly transfigured by the camera's magic.

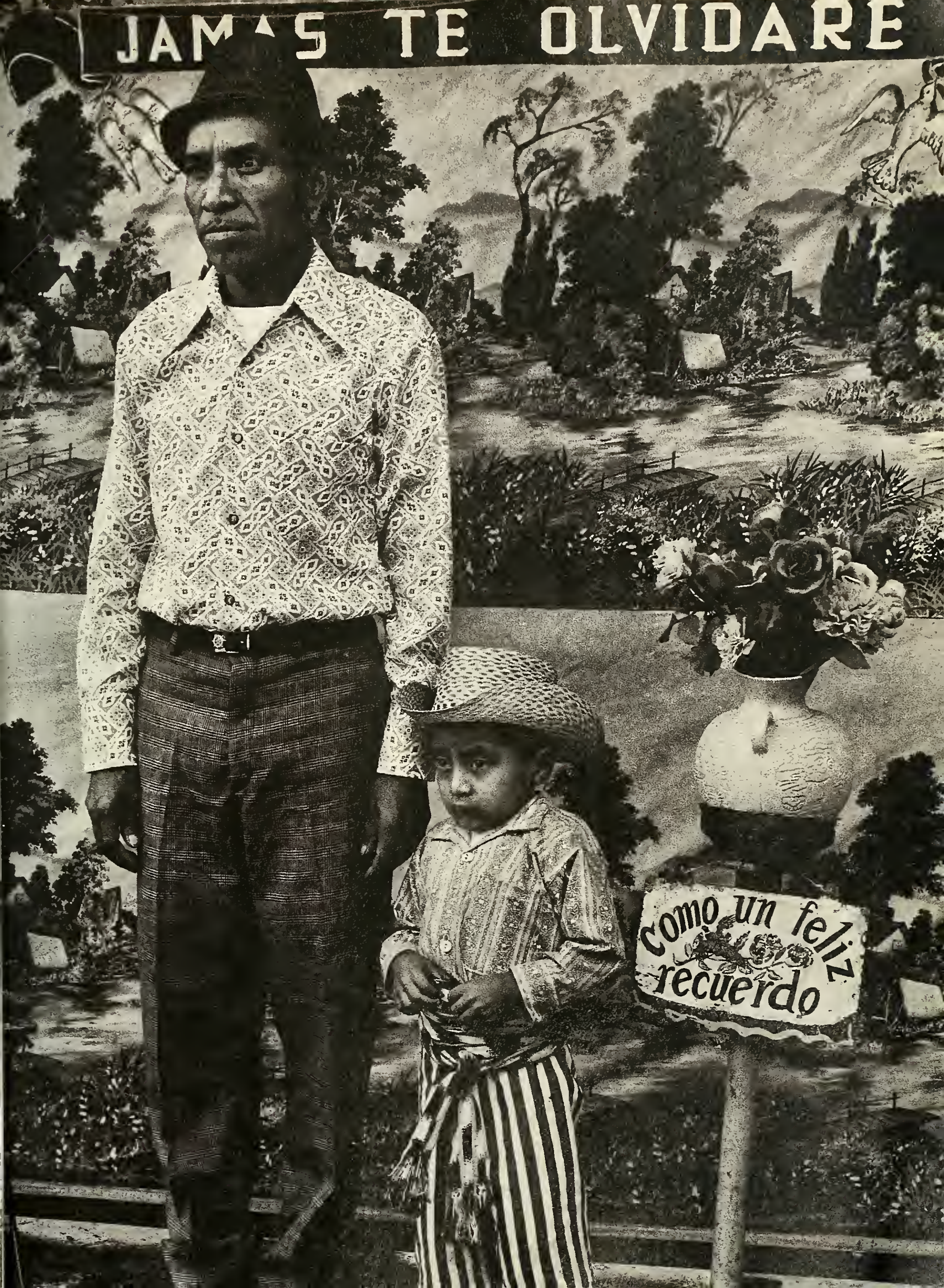
There are also practical reasons for having one's picture taken, and these constitute a considerable share of the photographer's work—especially when there is no local studio. As bureaucracy has encroached more and more on daily life, the demand for photographs has risen. Most common are the mundane photographs that accompany many official documents. An identification card, called a *cêdula*, is technically required for every person over the age of eighteen. Itinerant photographers provide the most economical, and often the only, means of obtaining the photographs required for various documents, such as organization membership cards, army conscription papers, and driver's licenses.

An estimated three hundred qualified photographers operate throughout Guatemala, of whom about half are itinerants. These fall roughly into two basic groups, divided geographically. Those from the Occidente (the western division) work mainly in the highlands. Many live in or around Quezeltenango, and a large number are members of a few families from the nearby village of Olintepeque. The Oriente faction is concentrated in the area of Zacapa and covers fairs in the lowlands of eastern Guatemala. Between these two groups are about forty street and park photographers who reside in Guatemala City and occasionally travel to fairs in both directions.

Members of the same family often pursue the uncertain life of the traveling photographer; fathers and sons, brothers, cousins, uncles, and nephews work the fairs together. A younger person usually helps out as an apprentice until he learns the trade well enough to go into business for himself. By that time he has either constructed his own camera or purchased one from another photographer. His first backdrop is likely to be no more than a plain cloth or a crudely lettered curtain. He might work several seasons before he can afford to invest in a fancifully painted background or a carved wooden horse. Once outfitted, the young man sets up with his colleagues, usually alongside the relative who instructed him. Just as veterans quietly leave the ranks, neophytes are accepted into the small community of itinerants without ceremony.

In nearly all societies operating at a low economic level, festive holidays are events of singular importance. Besides their social or religious functions, fairs and markets break the almost ritualized routine of day-to-day existence and provide the common meeting ground for exchanging rural and city products. On such special days even the most ordinary marketplace is transformed. Throngs of Indians begin arriving before daylight, and by mid-morning the selling and bartering are at a peak. Ladino townspeople mingle with mountain Indians in crowded stores and plazas as they shop amid tantalizing displays of seasonal fruits and vegetables, pottery, hardware, clothing, and bolts of commercial cloth patterned after typical native designs.

For itinerant photographers, the principals of all fairs are the Indians who pour in from the surrounding hills and valleys. For centuries, whole families and often entire communities of Indians have walked for days, traversing winding jungle trails, to reach a favorite fair. They arrive in the early daylight hours at such centers as Barillas, Huehuetenango, San Francisco el Alto, Totonicapán, Sololá, and Chichicastenango with their burdens of pottery, avocados, firewood, and grain. Many lead domestic animals or drive pigs and sheep before them; others bring clusters of turkeys slung over their shoulders or carry chickens nestled in reed baskets balanced


JAMÁS TE OLVIDARE
como un feliz recuerdo

on top of their heads. Women carry eggs neatly gathered into folded leaves or corner-tied squares of faded cloth, along with herbs, handicrafts, flowers, and whatever else they can sell or trade. Each district contributes its own specialty. People barter for necessities, visit with neighbors, pay their respects to the church, feast their eyes on a world of strange and wonderful sights, and sometimes—if they have good luck in the marketplace—spend some hard-earned coins on photographs.

Resplendent in their colorful costumes and jewelry, the crowds of visiting Indians move along the bustling thoroughfare where itinerants have set up their cameras in a closely packed row of glittering temptations. Mothers with babes on their backs or at their breasts and with children in tow, awkward young men and bevies of giggling girls, and seam-faced old men and women pause to inspect the frames of posted pictures. These display boards are usually hinged together in units of three or four and hung vertically from awning poles so that prospective customers can study them. Such displays are always popular. They attract crowds of shy girls and curious young men who search among the photographs for familiar faces from previous fairs and flirtatiously goad each other into having pictures taken. Even on a slow day these pictorial panels attract passersby who contemplate the collected images before moving on to attend to the real business of their day. Fascinated children amuse themselves for hours in this manner, slowly moving from one photographer's booth to another, cherishing the faint hope that they, too, might be photographed before the fair ends.

Photographers' props are fairly standardized. The principal requirements are that they be eyecatching, useful, and portable. Each photographer has at least one folding chair, more than likely painted a bright color. This is commonly used for single or group portraits, for setting toddlers on, for storing bundles while a client poses, or when business is slack, for the photographer himself to rest upon. Each set also features a bunch of travel-weary plastic flowers stuck into a cheap jug, tin can, or old thermos bottle nailed to a flimsy little stand. Oddly, this still life seems present more for tradition than for any other purpose, for it is seldom included in the sittings. Sometimes a replica of one of these stands or tables appears, complete with its bouquet of flowers, as part of a painted backdrop.

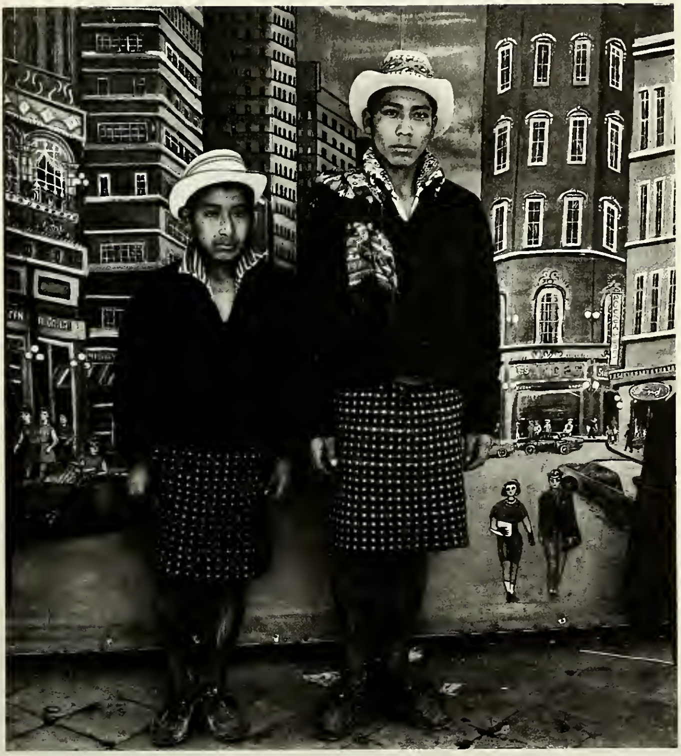
Much more popular are the *caballitos* (the sprightly painted wooden horses) and their cousins, the boldly striped zebras, which are standard equipment for most itinerant photographers. These comical little animals are sometimes delicately carved, and nearly all are decorated with saddles and other gaily colored equestrian trappings. A few are even polka-dotted in lurid colors or patterned with fantastic flowers that appeal immensely to children. The appeal, however, is purely visual, for young children usually scream with terror at finding themselves suddenly mounted astride such strange creatures. *Caballitos* cost about $45 and are a major investment for photographers. In Guatemala City a relative of one of the itinerants specializes in carving these miniature horses and supplies most of the present-day market. Lighter models are constructed of papier-mâché, heavily gessoed and shellacked for durability.

When the horse is trotted out there is usually an accompanying ensemble consisting of a Mexican-style sombrero, a cartridge belt with leather holsters, and a pair of wooden six-guns to complete the illusion. It is a seductive combination for exuberant young men who wish to show off in front of the camera. It lures older men as well, especially those who have imbibed enough of the fiery *aguardiente* to remind them of cowboy movies or their own youthful ranching days. The men behind the cameras are seemingly unperturbed by drunken behavior; they manage these clients as effectively as they do frightened and howling children.

As primitive paintings, the elaborate scenes used as photographic backdrops are a genre unto themselves. Generally painted in glaring colors on stitched-together pieces of heavy canvas, they measure six to eight feet square and are hung tautly stretched from horizontal poles. These curiously painted backdrops are

usually called *paisajes*, or "landscapes." The *paisajes* are imaginatively conceived and executed, although, as is true of much primitive painting, their composition often borders on the chaotic. The artists who are commissioned to paint them employ a crude perspective that delights the eye as it strives for added dimensions. Architectural motifs are sometimes boldly outlined in black, giving the whole a stark, illustrative quality reminiscent of early hand-colored woodprints.

Backdrops fall roughly into four categories. Probably the most popular are those showing important landmarks—churches, national shrines (a prime example being detailed representations of Guatemala's National Palace), or panoramic park scenes. Related, but different in mood, are contemporary metropolitan scenes with towering buildings, business signs, and crowded thoroughfares. One fascinating example, probably inspired by a picture postcard, portrays a cityscape of ultramodern buildings, identified by the caption "São Paulo, Brasil." Another, equally intriguing, features the artist's vision of Peru's bustling capital and is labeled "Avenida 'Wilson,' Lima, Peru, America del Sur." It is not unusual for a rural Indian family to choose an urban scene, perhaps because it suggests that



they have actually journeyed to such a metropolis. Although the name of the city is often plainly spelled out on a design, Indians usually are not aware that they have chosen to be photographed in a foreign setting.

Another type of backdrop depicts fantasy scenes with storybook castles, arched stone bridges, flowing fountains, angels, swans gliding on placid lakes, and, not infrequently, the quetzal, Guatemala's national emblem, in flight across a highly romantic landscape.

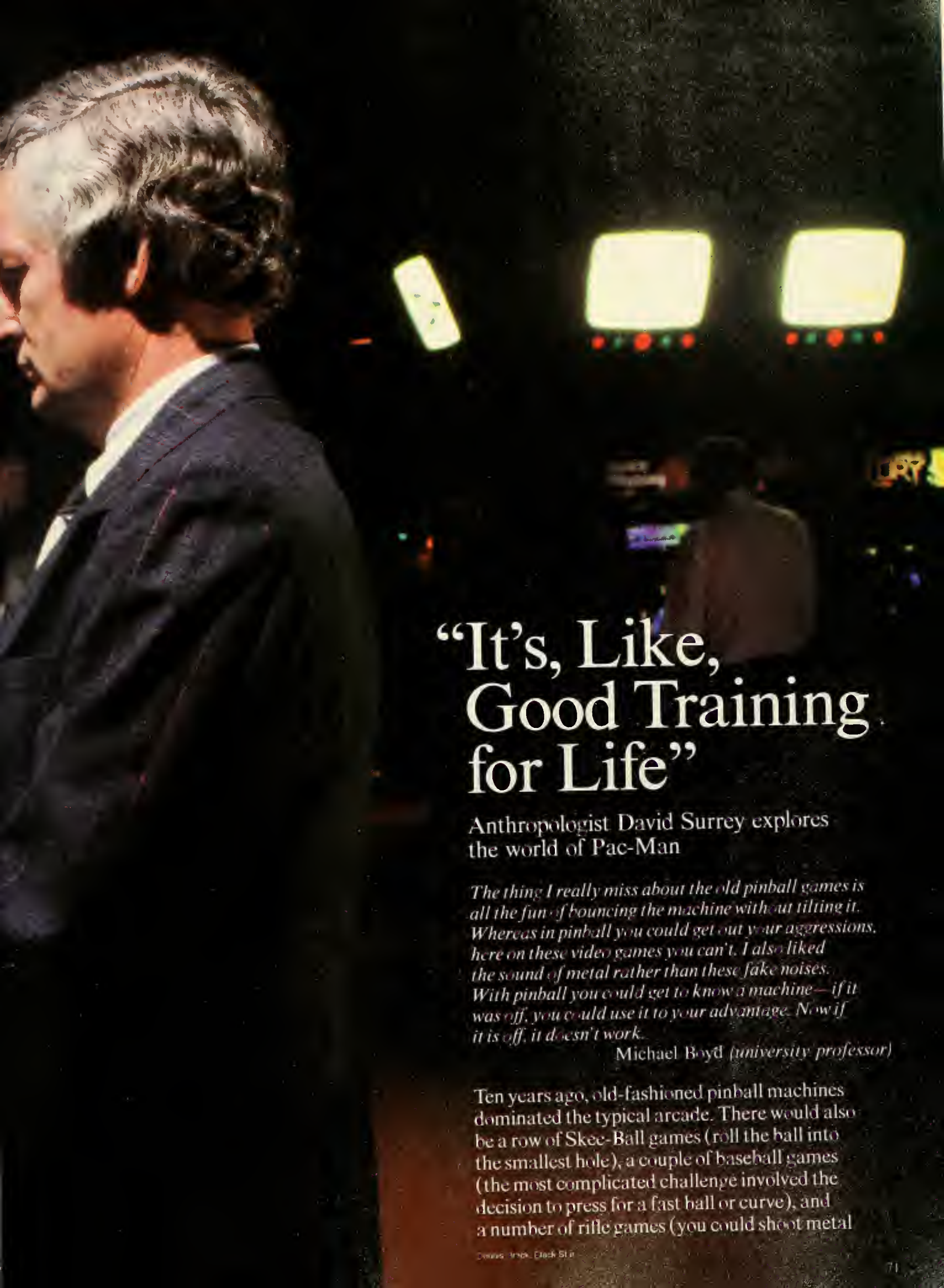
There is also a broad range of memento-type backgrounds. These introduce stylized drapery, flower- or vine-wreathed columns, and flying banners inscribed with sentiments ranging from the simple *Recuerdo* ("remembrance") to *Recuerdos de hoy y siempre. Si te alejas acuerdate de mi* ("Memories of today and always. If you go away, remember me"). Common also to these designs are lavish floral arrangements, the symbolic quetzal roosting on a pedestal, and fluttering doves holding messages in their beaks. A very popular background from Huehuetenango is inscribed *El paraíso de mis recuerdos* ("the paradise of my memories").

A dark coat (usually the photographer's own) and a black clip-on necktie are available if patrons want formal portraits. After a quick consultation the photographer helps his customer into the coat, adjusts the tie, then seats him in a dignified pose, usually in front of a wall or a plain dark cloth. The transformation of a country-costumed Indian by the mere addition of an ordinary suit coat and tie can be dramatic.

Much indigenous charm is lost from the portraits because Indians prefer formal poses. Men usually remove their hats, causing their features to take on an entire change of character. Women who come to market bearing colorful bundles on their heads or wearing fantastic headdresses take them off before stepping in front of a camera. And they cover their native blouses with gaudy factory-made sweaters. In such cases, the photographic results are less exciting than the exotic visions that first presented themselves to the photographer. Once in a while customers supply their own props, requesting to be photographed with a portable radio, a newly purchased kettle, or some other cherished object to be commemorated. It is not unusual for people to be photographed with chickens, turkeys, or even piglets in their arms.

Especially intriguing is the intensity with which Indians from highland villages react to being photographed. Their almost trancelike expressions, so reminiscent of the formal portraiture found on tintypes and daguerreotypes, clearly show that for them the camera still retains much of the powerful magic it had in its earliest years. In our society, where it is not uncommon for people to be photographed hundreds of times, the psychological impact of facing a camera is greatly diminished. For many of these Indians, the casual snapshot plays no part in their existence, and the rarity of coming before a lens is reflected in the portraits. Even such softening details as the backdrops, the props, or the informality of a child's gesture seem to heighten, rather than destroy, the basic mood.

Although signs of change weigh heavily over the world of *los ambulantes*, there is no indication that it will come about immediately. The tradition remains strong and true. For a while yet, these intrepid adventurers will be packing their gear and following the roads that lead to the next run of village fairs. Wherever celebrations are being held and there are people willing to part with a few cents for photographic mementos, these men will be on hand to accommodate them. ☐



“It’s, Like, Good Training for Life”

Anthropologist David Surrey explores the world of Pac-Man

The thing I really miss about the old pinball games is all the fun of bouncing the machine without tilting it. Whereas in pinball you could get out your aggressions, here on these video games you can’t. I also liked the sound of metal rather than these fake noises. With pinball you could get to know a machine—if it was off, you could use it to your advantage. Now if it is off, it doesn’t work.

Michael Boyd *(university professor)*

Ten years ago, old-fashioned pinball machines dominated the typical arcade. There would also be a row of Skee-Ball games (roll the ball into the smallest hole), a couple of baseball games (the most complicated challenge involved the decision to press for a fast ball or curve), and a number of rifle games (you could shoot metal

Dennis Brack, Black Star

The new electronic video games have drawn players from both sexes and all walks of life.

Phil Huber, Black Star

animals or bad guys, who either ran across the background or popped up behind the sagebrush). The crowds were sparse, and the sound was that of bouncing metal pinballs. In 1972 came PONG, an evolutionary link, not destined for survival, which created a revolution. Made by Atari, PONG was a simple video-display paddle game with an annoying little beep sound. It offered little variety of movement and despite elaborate wiring provided only about two hundred standardized responses. PONG, with its television screen and moderate success, marked the video equivalent of our ancestors coming out of the trees and standing upright.

The introduction of microchips spelled the end for PONG, pinball, the rifle games, and Skee-Ball. These chips, with their potential for hundreds of thousands of varied maneuvers, made PONG look very dull. The 1979 debut of Space Invaders, the video equivalent to our Cro-Magnon, permanently altered the floors of the arcades. Long lines of new customers formed, with T-shirted teen-agers waiting alongside adults in business suits.

Yet things change fast in the space age. "I got bored with Space Invaders, so I switched to Galaxian," says Chad Boyd, Michael Boyd's fifteen-year-old son. "It's harder because it moves in different patterns. Its laser comes at you much faster. It has all kinds of colors, it's three dimensional, and it has better noises. It's harder to play and fun to see. It's more exciting." Within two years, Space Invaders itself had become obsolete, losing out to such direct descendants as Deluxe Space Invaders, Galaxian, Defenders, and to new concepts—Donkey Kong and Pac-Man. Space Invaders brought in new customers, forced out old machines, and disappeared. Today one must search the far corners of arcades to find even one Space Invaders. And Chad is right: by today's standards, this 1979 machine is boring.

Today no one genre of video machine dominates. While alien spaceships still pose the most serious threats to humanity, an assortment of gremlins, gorillas, donkeys, and cartoon characters can be engaged. And these have been joined by a new-fangled pinball machine that lacks the metallic sounds and the tilt. The new pinball shrieks with sirens, spans three dimensions, talks, and spits out three, instead of five, balls; slamming the machine can get you thrown out of the arcade.

Despite the growing variety of games, the arcades have a certain visual uniformity. With machines lined up against the side walls, the parlors give the appearance of, in the words of nine-year-old regular Noah Freedman, "entering a real long train." In larger establishments, found especially in suburban or rural areas, another row of machines fits down the middle. The suburban arcades are often dominated by blaring stereo music, adding to the sensory overload. They also offer the opportunity to fend off aliens while standing on carpeted floors. In the cities, where space is at a premium, the arcades are more crowded. The floors are usually bare and the lighting dimmer. Ten-year-old suburbanite Steven David complained, during a visit to a New York City arcade, that he couldn't see what he was doing. By contrast, a Philadelphia teenager named Alfonso dislikes arcades with bright lights: "They reflect off the screen; you can't get over [win]."

Most arcades are dominated by the current rage: at this writing, Pac-Man. The

An important message from PAUL NEWMAN and JOANNE WOODWARD

"We share our love with seven wonderful children we have never seen.

"We'd like to tell you why."

The seven children the Newman family sponsors are Pedro, Gustavo, Carlos, Johnny, Andres, Jaime, and Laki.

"**For 16 years we've been Save the Children sponsors.** We began by sponsoring a desperately poor little girl from the mountains of Colombia—a child who lived in a one-room hut and could only dream of attending school.

"It was a joy to share our good fortune with her and to know that she was blossoming because someone cared enough to help. It made us want to help other children in the same way. And now we sponsor seven children around the world. Children we have come to understand and love. Thanks to Save the Children.

"If you've ever wondered 'What can one person do?'—the answer is 'You can help save a child.' If you are touched by the plight of needy children, there is no better way than Save the Children to reach out to them with caring, comfort, and support.

"Please join us as a Save the Children sponsor. We've seen the wonders they can work. You'll see how much you really can do—in the eyes and in the progress of the child you sponsor. You'll bring new hope to a child you'll know personally, as we do, through photographs...reports...and letters you can exchange, if you wish.

"You'll see despair turn to hope, and you'll feel the personal reward of knowing what your love and support can do.

"The cost is so little. The need is so great. Won't you join us as Save the Children sponsors?"

A sponsorship costs only $16 a month—less than many other sponsorship agencies. Just 52¢ a day. Because 50 years of experience has taught us that direct handouts are the least effective way of helping children, your sponsorship contributions are not distributed in this way. Instead they are used to help children in the most effective way possible—by helping the entire community with projects and services, such as health care, education, food production and nutrition. So hardworking people can help themselves and save their own children.

Fill out this coupon...and share your love with a child.

☐ Yes, I want to join the Newmans as a Save the Children sponsor. My first monthly sponsorship payment of $16 is enclosed. I prefer to sponsor a ☐ boy ☐ girl ☐ either in the area I've checked below.

- ☐ **Where the need is greatest**
- ☐ Africa
- ☐ American Indian
- ☐ Appalachia (U.S.)
- ☐ Bangladesh
- ☐ Chicano (U.S.)
- ☐ Colombia
- ☐ Dominican Republic
- ☐ El Salvador *
- ☐ Honduras
- ☐ Indonesia
- ☐ Inner Cities (U.S.)
- ☐ Israel
- ☐ Lebanon
- ☐ Mediterranean
- ☐ Mexico
- ☐ Nepal
- ☐ Southern States (U.S.)
- ☐ Sri Lanka (Ceylon)

* LIFELINE Sponsorship—$14 monthly

Name____________________
(Please print)

Address____________________

City__________ State________ Zip________

☐ Instead of becoming a sponsor at this time, I am enclosing a contribution of $______.

☐ Please send me more information.

Save the Children®
50 Wilton Road, Westport, Connecticut 06880
Attn: David L. Guyer, President

Established 1932. The original U.S. child sponsorship agency. YOUR SPONSORSHIP PAYMENTS AND CONTRIBUTIONS ARE U.S. INCOME TAX DEDUCTIBLE. We are indeed proud of our use of funds. Our annual report and audit statement are available upon request.

© 1982 SAVE THE CHILDREN FEDERATION, INC.

NH 11/2

The Wilderness Travel
World of Discovery

Wildlife & Natural History Tours
Anthropology & Archaeology Tours
Trekking Expeditions
Jungle Exploration

• CHINA •
• Kenya • Tanzania • Galapagos •
• Peru • Ecuador • The Amazon •
• Nepal • Australia •
• Alaska • New Guinea •

Write for our 32-page
fully illustrated catalog

Name
Address
Zip

WILDERNESS TRAVEL
1760-N Solano Avenue, Berkeley, California 94707
(415) 524-5111

Knit In
New England
Jackie Cooper's
FOLK ART
SWEATERS
featuring your
favorite farm
animals.
Shown: Horses
on Snow $72.

Send $1 for a catalogue of our
Folk Art Sweaters, Suedes and Lace.
Star Route Co., Box 188 J Ashfield, MA 01330

remaining games are usually grouped in threes and fours. New games preview alone or in pairs, on a sink-or-swim basis. The line of video machines is occasionally broken by a cablike structure, in which the player sits to pilot a race car, spaceship, or fighter plane against all kinds of dangers. The new pinball machines are usually placed in a corner by themselves—their twenty-first-century status uncertain. Each video game offers a virtual cosmic light-and-sound show unto itself. The colors are bright and varied; the visual effects equal the latest screen spectaculars; and the noises range from talking machines to screeching sirens and large explosions when missiles connect.

Sweeping the world, this industry swallows 20 billion quarters annually. National tournaments sponsored by the manufacturers attract many enthusiasts, and books and magazines devoted to the games are thriving. New arcades are everywhere, and unless they are banned, machines are found squeezed into delicatessens, pizza parlors, cinema lobbies, bars, diners, laundries, and even colleges and churches. "The noise drives me nuts, but with all the people around, we are less likely to be robbed," says a woman who operates a stationery store in New York City's Lower East Side.

Henry Cornelison, an operations manager for Magna Fun, a national chain of arcades, comments that "at one location, the largest number of patrons might be older teens, twenties. At a lot of our locations we have a large business crowd, business people . . . women coming in during their shopping, pre-teen-age or young teen-age kids. Overall we have all kinds of people." Every arcade I observed—urban, suburban, or rural—attracted varied types of customers. Distinct patterns emerge from the seeming variety, however. The following twenty-four-hour weekday sequence was derived from observations in several arcades in New York City and Philadelphia.

Midnight to dawn: The crowd is virtually all male; players are mostly in their early twenties, usually alone or in pairs. A smaller number of late-teen-agers, mostly male, tend to be in groups of three or more.

7:00 to 9:00 A.M.: Here come the Suits—white-collar males in their late twenties and early thirties in for a quickie before work. A quickie can easily last up to one hour. (They keep their ties tight—perhaps to give themselves the impression that they indeed will stay only for that mythical "last game.") More casually dressed male workers of the same age group enter. Almost all are alone.

9:00 A.M. to noon: Much more informally dressed men, usually in their teens and twenties, appear. Again, they are usually alone.

Noon to 2:00 P.M.: Here come the Suits again; this time, often in pairs. With some non-Suit male workers, they vie for the machines with the nine-to-noon crew. If the arcade is near a high school, it is invaded by groups of students, mostly male but including some females.

2:00 to 5:00 P.M.: School kids—high school on down—predominantly male, mostly in packs, begin to control the machines. For the first time, significant numbers of females appear, but they are often relegated to the cheerleader role. Some of the younger kids may bum quarters—the only panhandling I observed.

Stimulation or sensory overload?

Dan McCoy, Black Star

50 Gold and Prize Medals
50 Gold and Prize Medals
"White Label"
DEWAR'S
BLENDED SCOTCH WHISKY
100% SCOTCH WHISKIES
PRODUCT OF SCOTLAND
BLENDED AND BOTTLED BY
John Dewar & Sons Ltd.
PERTH
SCOTLAND.
750 ml
(25.4 FL.OZ.)
86.8° PROOF.
DISTILLED BLENDED AND BOTTLED IN SCOTLAND
SOLE DISTRIBUTORS IN U.S.A. SCHENLEY IMPORT COMPANY N.Y.
DISTILLED AND BOTTLED IN SCOTLAND
UNDER BRITISH GOVERNMENT SUPERVISION

In Scotland's Strathdearn vale, breeding fast hunters is more than a matter of pride. It's a family tradition. Like father, like son, like grandson. The good things in life stay that way.

DEWAR'S®
"White Label"®
never varies.

Authentic.
The Dewar Highlander

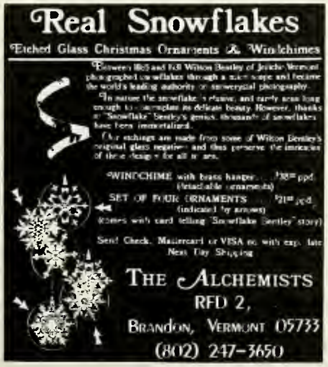
® BLENDED SCOTCH WHISKY • 86.8 PROOF • © 1982 SCHENLEY IMPORTS CO., N.Y., N.Y.

TRINIDAD RAIN FOREST

The **ASA WRIGHT NATURE CENTRE** offers the most convenient introduction to this rich tropical world of nature. Located on the northern mountain range, the Nature Centre provides a comfortable and attractive retreat.

- Rustic plantation setting
- Guides available
- Field trips
- Excellent photographic opportunities
- Five summer seminars

Write or call: **WONDER BIRD TOURS**, Dept. A10, 500 Fifth Avenue, New York, N.Y. 10036. Phone: 212/840-5961.



Real Snowflakes

Etched Glass Christmas Ornaments & Windchimes

Between 1885 and 1931 Wilson Bentley of Jericho Vermont photographed snowflakes through a microscope and became the world's leading authority on snowcrystal photography.

In nature the snowflake is elusive, and rarely seen long enough to contemplate its delicate beauty. However, thanks to "Snowflake" Bentley's genius, thousands of snowflakes have been immortalized.

Our etchings are made from some of Wilson Bentley's original glass negatives and thus preserve the intricacies of these designs for all to see.

WINDCHIME with brass hanger.... $38.00 ppd.
(detachable ornaments)
SET OF FOUR ORNAMENTS .... $21.00 ppd.
(indicated by arrows)
(comes with card telling "Snowflake Bentley" story)

Send Check, Mastercard or VISA no. with exp. date
Next Day Shipping

THE ALCHEMISTS
RFD 2,
BRANDON, VERMONT 05733
(802) 247-3650

Treasures From The Earth

Color Portfolio of Natural Specimens and Catalog of Minerals, Display Stands, Books and Natural Jewelry, $3.00

Dover Scientific
Box 6011C Long Island City, NY 11106

In the spring and fall of 1983 we repeat our popular program for travelers who enjoy outdoor things:

Naturalist's Tour of the Scottish Highlands

MAY AND SEPTEMBER, 1983

We stay at small country inns and, by special permission, on the island of Rhum in the Inner Hebrides. We hike across moors, through forests and in unspoiled mountains among alpine flowers, sample local dishes and fine whisky, meet Highland people and listen to the sound of bagpipes.

Detailed brochures of this tour and a copy of our newsletter which lists all our fascinating travel programs, available from:

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

5:00 to 7:00 P.M.: Suits and, increasingly, non-Suits return and merge with the above. There seem to be fewer females during this time.

7:00 to 8:00 P.M.: No change occurs, unless the arcade is near a theater or cinema, in which case families or couples may drift in, with the women beginning to look disdainful to disgusted.

8:00 P.M. to midnight: Male teen-agers dominate the arcade, usually in groups. Some older males and a few women are also present.

The population of males in the suburban arcades tends to be younger and "whiter" than in the city. The proportion of young children is especially high at the shopping mall arcades, as mothers either rest nearby or let the machines do the babysitting for them. Mommy rarely plays but can be touched for a quarter now and again.

Vying for machines should not be envisioned as a matter of pushing and shoving. Custom regulates. The person "on deck" places a quarter next to the coin slot. In months of observation, I never saw anyone denied access after this ritual placement. The sailing is not always smooth, however. At more popular games, you may find a long line of quarters ahead of yours. Or the person ahead of you may be an "ace," capable of continuing one game for what seems to be an eternity. (In tournaments, a dozen hours on one quarter is not unusual for those who are skilled.) Some prospective players encounter another problem: nine-year-old Noah Freedman "usually can't reach the top of the machine" to place his quarter.

For an extra quarter, the machines permit two players to alternate turns, with their respective scores displayed in lights at the top of the machine flanking the all-time high score. Some players, especially friends, take pleasure in competing against each other; the interest of others is focused on competing against the all-time high. During peak hours, two-person playing is more common, and when quarters are lined up, the loser must yield his or her place to the next contender. Players can thus compete for the right to stay at the machine. It is not unusual for strangers of different ages and social classes to battle for rights to take on the next challenger—and in these competitions, the T-shirts usually outmaneuver the Suits.

Verbal communication is taboo. Talking with people other than your friends identifies you as a neophyte, chump, or reporter. Arcades are not easy places to meet people. The noise, the concentration required by the game, and the fact that only two at a time can play a given machine make socializing almost impossible. It is extremely difficult to start a conversation such as, "Hello, I am an anthropologist and would like to ask you a few questions."

Thirty-two-year-old Larry Rivera describes Defenders:

> The object of the game is to score points, eliminate certain pieces that appear on the screen. You have to be able to maneuver your ship into position, so that you can shoot them.

Noah Freedman explains Wild Western:

> There are cactuses in front of you, and on the other side there is a train. . . . There are about five bandits, and you have to shoot them down before they shoot you . . . they get in the water barrel. If you lose all three sheriffs the game is over.

These descriptions capture the essence of all but the most recent arcade video games, and go far to explain the arcades' special appeal to males. The games offer modern versions of the old broomstick cowboy activities that boys, not girls, have been encouraged to play. As social psychologist Michelle Fine notes, "Girls haven't been encouraged to express aggression—certainly not to be comfortable with war or combat games. At least not in *public*." Some males clearly see the connection with aggressive feelings. "It's, like, good training for life," says Gary Michael, age 40. "You gotta learn how to dodge and learn when to shoot." Teddy Fontanez, in his late teens, says, "For me, what they do is calm my nerves. Everytime I get angry or something, I go play the machine. Then I'm cool."

The introduction of nonmilitary games, such as Pac-Man and Ms. Pac-Man, have drawn significantly more females to the arcades. Yet the Pac "persons" are as popular with males as they are with females. Pablo Ruiz likes "just one particular game, Ms. Pac-Man . . . the fruit doesn't stay in one place. It travels." (Teddy Fontanez offers a different opinion: "Ms. Pac-Man is just, it's just stupid. The way the fruits bounce up and down.")

Beyond socialization, what attracts a particular person to a particular game seems to be a combination of challenge and individual inclination. Once the challenge has worn off, as was clearly the case with the limited maneuvers and colors of Space Invaders, the dreaded label of "boring" dooms the machine. Jacqueline Chan, in her late teens, discusses her own experience:

> At first I used to stay at one machine, Pac-Man. Then I got tired of it. Centipede was quite the same, and I got tired of it, taking it

GIVE NATURAL HISTORY

**This Holiday Season give one gift at $15
and save 20% on subsequent gifts at $12 each**

☐ YES, send ______ gifts, which include 12 thought-provoking issues of Natural History and all the benefits of a one-year Associate Membership in the American Museum of Natural History.

GIFT TO:

Name ________________________________

Address ______________________________

City _________________________________

State __________________ Zip __________

GIFT TO:

Name ________________________________

Address ______________________________

City _________________________________

State __________________ Zip __________

Mail this Postage-paid card Today!

GIFT FROM: J565

Name ________________________________

Address ______________________________

City _________________________________

State __________________ Zip __________

☐ Payment enclosed ☐ Bill me

Charge my ☐ Visa ☐ Mastercharge
☐ American Express

Account number
☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Signature ____________________________

☐ 1 Gift at $15 . . . . . . $15
☐ Additional Gifts at $12 . . ______
(20% savings)
Total Enclosed $ ______

Outside U.S.A. please add $5 for postage

Moneyback guarantee if not satisfied

Special Money Saving Gift offer!

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO 30 BERGENFIELD, N J

POSTAGE WILL BE PAID BY ADDRESSEE

NATURAL HISTORY
P.O. Box 4200
Bergenfield, N.J. 07621

> around and around and around and around. You get tired because you get too good, and you can't find no competition. So you switch to another machine.

And Solomon Forbes, thirty-four, finds the challenge of Pac-Man wearing off after seven months:

> Pac-Man seems to be winding down a little. When I started, I had a goal of 20,000, then 30,000, then 50,000, then higher and higher until 100,000 and 200,000 and 500,000. Now I can get up to one million, which takes two hours on one quarter. The game has lost some of its excitement. That's why I may be switching to Galaga. On the other hand, if I play Pac-Man on one quarter, I won't spend so much money.

Socialization to a new machine involves a patient process of imitation, rather than verbal or written instructions. A crowd gathers at the opportunity to watch an ace dominate a machine, and individuals try to decipher the strategy. Successful players freely admit that they became skilled by watching others. Instructions, either printed next to the coin slot or flashed across the video screen, are, as Chad Boyd observes, "not that great. The best way to learn is to watch somebody else."

"In my business," an understandably anonymous source confided,

> you go where the marks are and this is where it's at. They're into zapping these machines, with their butts sticking out. This may seem strange to you, but their wallets say to me, "It's a drag in here. Take me home." Hey, and I'm doing the guys a favor, too. They waste their time and money here; their old lady she gets mad. So I take their wallet once and maybe they won't come in here so much.

As this man suggests, a video parlor is an easy place to lose one's wallet, rivaling sporting events or a crowded bus. On the other hand, despite the somewhat sordid reputation of the arcades, crime does not fester in most of them. The one major exception might be drug trafficking. A widely reported survey of more than 100 New York City arcades reports "some" drug use in more than half of them. Perhaps; but "some" is a nebulous term. I saw no regular drug activity. What little I did witness occurred outside, rather than in-

Not
Responsible
—for—
Demages
Loss-Theft
or Fire.

Bud Lee

Key West, Florida

J.M.W. TURNER OFFER

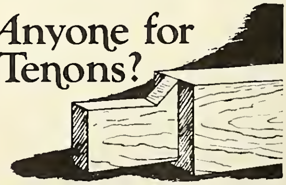
***Castle Upnor, Kent:** (22 X 18 in.)*
***Painted 1830:** Private Collection England.*

Superb quality colour print of a strikingly beautiful Turner watercolour. Warships lie at anchor silhouetted against the setting sun, while in the foreground fishermen prepare for the homeward journey as evening sets in. Art historian John Ruskin wrote, "This is a wonderful example of Turner at the peak of his powers."
Just one thousand copies of this painting were printed in England to commemorate Britain's Maritime History Year. We have every one of them. There will be no more available once these few are gone.

Print $16 (Framed $59.90)
Calif. rsidents add 6½% tax. Tel (213) 452-2443

OXFORD GALLERIES
2210 Wilshire Blvd., Suite 627
Santa Monica, CA 90403

Name____________________
Address____________________
City __________ State_____ Zip_____
☐ VISA ☐ M C #__________ Exp ________



Anyone for Tenons?

If your racket is tenons, doubles or singles, and you want a perfect match every time, you can learn from the professionals. They know a classic way to join two pieces of wood together is with a tenon that fits into a mortise.

Fine Woodworking magazine speaks this language to more than 200,000 readers—people seriously interested in making beautiful things out of wood. Whether you are an aspiring novice or an accomplished expert, you'll find it an especially informative magazine. It features finely detailed articles about techniques and tools, materials and design, written by master craftsmen who share their many years of woodworking experience. And it's printed on heavy paper to withstand years of reference. All back issues are in print and indexed periodically.

If you want to become a better woodworker, send $14.00 for a one-year subscription (6 issues). Or call us toll-free, 1-800-243-7252, to charge your order (Ct. residents call 1-426-8171). If you're not pleased, we'll be happy to refund.

Fine WoodWorking

The Taunton Press
52 Church Hill Rd.
P.O. Box 355D1
Newtown
Connecticut 06470

Our handy knife-rule fits as neatly in your pocket as it fits your needs.

You've never owned anything like this. Not only is it a stainless steel pocket knife that's just 3″ long and 3/16″ thick when closed—with two blades of fine Sheffield steel. It's also a 6-inch precision rule engraved by Rabone-Chesterman of England, who are known the world over for precision rules. But, the best part of all? You don't have to go any further than your pocket for it.

Send for the Garrett Wade Knife-Rule and our introductory catalog. It's full of fine woodworking tools.

Garrett Wade Co.,
Dept. *116*
161 Ave. of the Americas
New York, N.Y. 10013
Please send me ____ pocket knife-rules(s) @ 29.90 p.p.d.
plus introductory Garrett Wade Catalog.

Card No ____ Expires ____
NAME ____
ADDRESS ____
CITY ____
STATE ____ ZIP ____

side, the arcades. (Generally, arcades even prohibit smoking, drinking, and eating.) According to one New York City cop, "It takes the kids off drugs. They have to be alert." In New York City, the closer the arcade to Times Square, the more likely the drugs. But this is true, arcades or not. Another charge is that gambling occurs frequently in the arcades. This has not been substantiated, and I observed no gambling during my visits. The only obvious betting involved groups of teen-agers pooling their quarters. As Pablo Ruiz says, "All that money—and the most it ever got to was six dollars—goes right back into the machine. We all treat each other."

Undeniably, the machines absorb a lot of people's time and money. Teen-ager Dennis Greene, a retired Asteroids ace, admits:

> Sometimes my habits come back. Like a week ago, I had a quarter and I had five extra dollars in my pocket, and I played. I didn't get the high score, and I thought I could do better, so I went and changed my money.

"Observing them as not just a parent but as a concerned citizen, I am really concerned about the amount of money the kids put into those things," comments college counselor Zil Groux, a mother of nine. "It almost seems like an addiction, and yet I suppose to some extent it's a lot better than other addictive things." All those quarters represent big bucks, and if you want to know who profits and by how much, "no comment" is the standard reply, from the operator of the corner pizza stand to the spokesperson for the arcade chain. Some people spend five to ten dollars an hour, many hours a week, leading to unsubstantiated claims of teen-age crime waves as less well-heeled players strive to feed their addiction. Local restrictions imposed from Babylon, Long Island, to Oakland, California, have barred people under eighteen from arcades during the school day or ruled that minors must be accompanied by an adult. (These restrictions now face court challenges.) President Marcos of the Philippines ordered all machines out, declaring that they create "havoc on the morality of the nation's youth."

Certainly sacrifices are made. Some players give up movies, new clothes, television, lunch money, records, or junk food. Others give up active endeavors—basketball is cited most frequently by male teenagers. Some cut school; many adults stretch their lunch hour. This is not harmless, but anthropologist Richard Morris points out, "It would be naive to think that most of the time and the money spent on these video games would be channeled into anything society would label as productive."

Indeed, Morris, who works with inner-city youth out of the Philadelphia-based University City Science Center, is among a growing list of observers, professional and lay, who see positive influences of the games and the potential for greater benefits in the future. Meryl Freedman, Noah's working mother, thinks:

> It's really fantastic in certain ways. I think he's a really bright kid; I don't feel it's tak-

Mango, Florida

Bud Lee

F.S. Mitchell (Tom Stack & Associates)

Surprise

your favorite children with these wonderful Christmas gifts!

America's famous magazines for young people encourage the love of learning, help develop reading skills, and trigger intellectual curiosity. RANGER RICK'S NATURE MAGAZINE is adventure, knowledge, laughter, puzzles, nature games, costumes, jokes, science, wildlife, exciting stories, planets, stars, waterfalls, fantastic photos — *fun!* This award-winning magazine is great for school, too! YOUR BIG BACKYARD is the perfect starter magazine for preschoolers. Funny animals, easy games, coloring pages, read-to-me stories, crafts, poems, wonderful pictures, dot-to-dot fun, and good help on the road to beginning reading. A treat! Children will love these holiday gifts all year long, and they'll remember they came from *you!*

Ranger Rick's nature magazine

FOR KIDS 6-12

12 issues only $10.50

810440

The two magazines kids really love!

Ranger Rick and Your Big Backyard

Your Big Backyard

FOR KIDS 3-5

12 issues only $8.50

My Name ____________________
Please print
Address ____________________ Apt. # ______
City ____________ State ______ Zip ______
You'll be sent gift cards to sign and forward.

Send to:
Name ____________________
Address ____________________ Apt. # ______
City ____________ State ______ Zip ______
☐ Ranger Rick, $10.50 ☐ Your Big Backyard, $8.50

Send to:
Name ____________________
Address ____________________ Apt. # ______
City ____________ State ______ Zip ______
☐ Ranger Rick, $10.50 ☐ Your Big Backyard, $8.50

Additional gifts? Attach your list and add to total.
Add $4.00 for each address *outside* the U.S.

☐ TOTAL AMOUNT ENCLOSED $ ______

Make check or money order payable to and send to: NATIONAL WILDLIFE FEDERATION, 1412 16th Street, N.W., Washington, D.C. 20036

TELESCOPES

CELESTRON C8 TELESCOPE

Precision Optics From
CELESTRON®

Celestron offers a complete line of superb quality Telescopes, Spotting Scopes, Binoculars and Telephoto Lenses
- Available in 2.4 to 14-inch diameters
- All price ranges
- Most adapt to 35mm cameras

FREE product, ordering and price information, or send $3.00 for detailed color catalog on selecting/using our products.

CALL TOLL FREE 1-800-421-1526

CELESTRON INTERNATIONAL
P.O. Box 3578-NH, 2835 Columbia St.
Torrance, CA 90503

Name
Address
City State Zip

FOREIGN BIRD GUIDES . . .

Latest Field Guides to the birds of Africa, Asia, South America.

Extensive Catalogue of Natural History books (Out-of-print, rare, and new) $2.00

Patricia Ledlie—bookseller
Box 46 Buckfield, Maine 04220 U.S.A.
(207) 336-2969

Whole Natural
ALMONDS
from . . .
Treehouse
Farms, Inc.

Give a Special Gift this Holiday Season. The very finest almonds fresh and shelled are shipped directly from our orchards to you. Mail your order along with any special shipping instructions to:
TREEHOUSE FARMS, P. O. Box 168,
Earlimart, CA 93219.
SATISFACTION GUARANTEED.
Check, Money Order, Visa, Master Card
Elegant Foil Lined Gift Box
3-lb. Box $12.00 5-lb. Box $18.50

ing over his mind or making him passive. I feel that he is imaginative with it, that it's a good learning experience. I have a real different view of it than a lot of people . . . it fosters all kinds of inputs, makes him more imaginative. He's getting a preparation for the space age, for the computer age.

For a quarter, one gains access to state of the art technology. Brian Sutton-Smith, professor of human learning and development at the University of Pennsylvania and an international expert on children's games, states that "with the current explosion of video games, it is the first time that kids across social classes are given access to and experience with executive organization; they are perceptibly and strategically in charge of a sophisticated control system."

Carol Gordon, a New York psychologist, feels that the games "give teen-agers a sense of confidence, and equip them with computer-related skills for the future." She states that teen-agers "raised passively and frustrated by television now have the chance to interact with and control the media." Morris expresses a similar view, seeing these games with "their buttons and lights as a new means of learning, especially for people who would have normally been deprived of such a chance." Brian Sutton-Smith, too, remarking on the "immediate feedback, oportunity to self-correct," supports the games as great "educational vehicles."

The teen-agers themselves express their satisfaction in more concrete terms. Teddy Fontanez points out that he is "an ace at Asteroids, I can take it around three or four times," and Bailey Brown proudly announces that he created his own Pac-Man patterns: "I can win." Players brag of their accomplishments; they strut a sense of competence. Yet, the inflationary desire to do ever better exhausts time and quarters. New machines seduce those who would be king by flashing the initials of the all-time high scorers and of the top scorers of the day. (In ancient times, pinball wizards left their names and scores taped to the machines.) "I like Asteroids because you can put your name on it, if

VIDEO
G
STERN

New York City

Bud Lee

1 Million Famous LCD Quartz Calendar Watches To Be Sold For Only $5 Apiece In Mammoth Publicity Drive

---

All who wish to apply for a watch should write to the company before Midnight, December 25, 1982

NEW YORK—One million famous LCD Quartz calendar watches will be sold as part of a publicity campaign for only $5 apiece to the first one million persons who apply in writing to the company before Midnight, December 25, 1982.

These are the same nationally publicized LCD Quartz watches advertised in The New York Times, TV Guide, Parade and other leading publications, with a built-in computer so powerful it never needs winding and which is accurate to within seconds per month. Time and date are displayed in full Quartz digital mode; and a unique "backlight" allows viewing even at night or in total darkness.

These famous LCD Quartz calendar watches will not be sold at this price by the company in any store. The only way to obtain one at this price is to apply in writing to the company address (below) not later than Midnight, December 25, 1982.

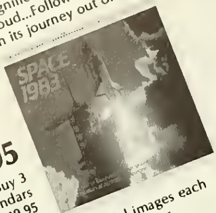
Each watch carries a full one-year money back guarantee and will be replaced by the company, free of charge, if it ever fails to function.

There is a limit of two (2) watches per address at this price, but requests which are mailed early enough (before December 17) are permitted to order up to 5 watches.

To apply for an LCD Quartz calendar watch, mail your name and address *and this original printed notice* together with $5 for each watch desired. Add only $2 shipping and handling no matter how many watches you are requesting. NOTE: Specify model and color choice for each watch as follows: Men's Gold (Item #20710A), Men's Silver (Item #20720B), Ladies' Gold (Item #20730C), Ladies' Silver (Item #20740D). Mail to: **Delucca, Goldrich & Lord, Ltd., Calendar Watch, Dept. 569-20, Box 1020, Westbury, N.Y. 11595. (D20700)**

© 1982 Delucca Goldrich & Lord Ltd

ASTRONOMY'S SPACE 1983 CALENDAR...Visit the Moon with the Apollo 15 astronauts...Behold the magnificence of the Large Magellanic Cloud...Follow a battered Voyager 2 on its journey out of the Solar System...



$6.95
Buy 3 Calendars for $19.95
Get a 4th FREE
Postage Included

13 colorful images each 11½" x 11½", plus notable dates in astronomy, celestial events and holidays.

Yes, send me_____copy(ies) of ASTRONOMY's SPACE 1983 Calendar.
Enclosed is $__________
Name
Address
City State Zip G-8-1

Allow 4 to 6 weeks for delivery. Mail to: ASTRONOMY Magazine, ORDER DEPT., 625 E. St. Paul Ave., P.O. Box 92788, Milwaukee, WI 53202.

CRUISE TO THE WORLD'S HIDDEN CORNERS.

Visit penguin rookeries in Antarctica and isolated tribal villages in New Guinea. See the monuments of Burma and Sri Lanka and the ritual dances of Indonesia. Study the profusion of birds in the Seychelles and the exotic marine life of the Great Barrier Reef.

Learn from our accompanying lecturers and expert guides.

Our 120-passenger WORLD DISCOVERER is unique, with a combination of expedition capabilities, special landing-craft, and traditional cruise amenities.

Society Expeditions CRUISES
Dept. NH821IW 723 Broadway East, Seattle, WA 98102
I want to know more about Society Expeditions cruising programs. Please send me your 48-page catalog
Name
Street
City/State/Zip
M.S. World Discoverer Registered in Singapore.

you do good," says Pablo Ruiz. "If Pac-Man had that, it would be even better." Sammy Smith is similarly hooked:

> When you get your score up, you feel good 'cause you accomplished something. But when you come back later, and your score is down, you get mad. You keep sticking in quarters 'til you get it back. Those quarters add up, man.

An examination of many machines reveals that players sometimes forgo their chance to put up their own three initials and choose instead to approximate four-letter words.

Young teen-agers beam an especially proud sense of accomplishment as they defeat older players who are obviously better off financially. And usually youth does prevail over age in the video games. Perhaps this is because younger players devote more hours to perfecting their skills, but they also seem able to master more rapidly the increasingly complicated scenarios presented by the newer games.

Here is how twelve-year-old "Mikie" Oaks describes Donkey Kong:

> This little construction man, and he's like downstairs doing construction on the ground, and there is a monkey on top and a lady on top and the gorilla is throwing barrels down, and if you jump over the barrels you get 100 points—depends on the color of it—and you just go all the way up until you get upstairs to save the lady, and then you get a bonus. If you get hit, you lay on your back and jump in the air, and smoke comes out of your mouth.

The ultimate object of virtually all video games is survival. In the space games you must shoot them before they shoot you. In the Pac "person" genre, you eat them before they eat you. And in the comic character games, you assault the creature (usually banging it on the head with a shovel) before it assaults you. Does this suggest we are creating a generation of computer-directed killers? Historian Jack Colhoun feels that indeed "these games are a product of our times, as well as our future times. The arms race has been taken to its next step—outer space. The fantasy is not too far from reality." Colhoun's point is driven home by Red Alert. Players must defend the Western world, country by country, from progressive raids of jets, helicopters, night bombers, and other weapons (I couldn't get beyond the night bombers).

Solomon Forbes, a Pac-Man ace—and political refugee from South Africa—discovers something "very American" in the military video games:

> These games represent aggression against anything alien. If it's not an American, you try to shoot it. Anything alien must be insu-

Wildlife Tours

Wildlife safaris Tanzania, Kenya, Botswana
Gorilla viewing Rwanda
Andes, Amazon and Galapagos islands
many other trips
Travel with the experts

Adventures International
4421-N Albert St., Oakland, CA
(415) 531-6564

COLOR PHOTOGRAPHIC PRINTING

▼ CIBACHROME COLOR PRINTS OFFER PERMANENCE, BRILLIANCE AND FIDELITY TO YOUR ORIGINAL TRANSPARENCIES.

▼ At AZO LABS, we work closely with artists, museum directors and exhibition designers to produce the finest archival quality photographic printing, mounting and framing.

▼ *Please call or write for our free museum package which lists services and prices.*

AZO COLOR LABORATORIES, INC
149 Madison Avenue, New York, N.Y 10016 (212) 982-6610

GEO EXPEDITIONS
Escorted and Independent Tours

Wildlife, Ecology & Cultural Tours
Galapagos Islands Venezuela Kenya
Peru Ecuador Papua New Guinea
Tanzania Australia Indonesia
Micronesia Philippines

Remote Patrols
Peru
New Zealand
Australia
Indonesia
Iceland
Papua New Guinea

For free literature write or call collect
P.O. Box 27136-C Oakland, CA 94602
Telephone 415/530-4146

"INTRUDER" (Man & Shark) by Mico Kaufman
This is a stunning, graceful piece by a distinguished sculptor in a limited edition.
4½" x 5¼" x 4" • 950 s/n • Fine Pewter • $215
STEARNS & ASSOC., RFD 2, BOX 320, CHESTERTOWN, MD 21620 (301) 778-2166
Orig. Prints • Sculpture • Catalog • V/MCard

lated against. Any foreign thing must go down.

Nevertheless, in playing Galaga—a space wars game—he observes: "Even though I am shooting, it's not violent. It's the challenge of beating the objects on the screen." Similarly, Chad Boyd, in response to the question, "Are you killing aliens?" answers:

> I just play it for the skill. It's like a sport. Like playing basketball. I could be wiping out chairs; doesn't have to be aliens. It could be television sets, as long as it moves.

The success of the military space games cannot be denied, even though their popularity has been overtaken by that of the Pac-Man family. But militarism only partly explains the appeal of video games. The critical factor for most, even the space war enthusiasts, seems to be not the destruction of aliens but the challenge of first mastering and then conquering technology. Video games also can be compared to sports—although actual sport-theme games, popular in the home-video market, have been poorly received in the arcades. The games require strategy and physical hand–eye coordination, and many players actually work up a sweat. And there is competition—the thrill of victory and the agony of defeat.

Many argue that since survival is the point of almost all video games and eventually even the very best players do lose, there can be no winners at these games. They say that all games end with money lost and players frustrated. But would a basketball team that scored an all-time high and won by 40 points be labeled a "loser" because the buzzer ended the scoring? Of course not. In the arcades, winning comes by a variety of routes. Success involves mastering the machine, improving your personal best, beating your friend, or topping the high on the machine. As Sutton-Smith points out, "Anyone can find a measure of success and can experience success on these games."

For better or worse, our society is a competitive one—we are game oriented, and we need feelings of success. The video games touch these central aspects of our culture, and do so with the sounds, lights, and technology of the next century—the new technology that has attracted the young and the not-so-young to video versions of old games. As Richard Morris notes, the machines "combine everything modern with everything ancient. The stories and themes are as old as humanity. The themes are of adventure and conquest. Timeless themes which are channeled by state of the art technology." ☐

Speak French like a diplomat!

What sort of people need to learn a foreign language as quickly and effectively as possible? *Foreign service personnel*, that's who. America's diplomatic corps assigned to U.S. embassies abroad must be able to converse fluently in every situation.

Now you can make a start on learning to speak French just as these diplomatic personnel do — with the Foreign Service Institute's Basic French Course.

The U.S. Department of State has spent thousands of dollars developing this course. It's by far *the most effective* way to learn French at your own convenience and pace.

The Basic French Course consists of a series of cassettes and an accompanying textbook. Simply follow the spoken and written instructions, listening and repeating. By the end of the course you'll be learning and speaking entirely in French!

This course turns your cassette player into a "teaching machine." With its unique "pattern drill" learning method, you set your own pace—testing yourself, correcting errors, reinforcing accurate responses.

The FSI's Introductory Basic French Course comes in two parts. Part A provides an introduction to the simpler forms of the language plus a basic vocabulary. Part B introduces more complex structures and additional vocabulary.

You may order one or both parts of the Basic French Course:

☐ **Basic French, Part A.** 12 cassettes (17 hours) and 200-page text, $115.

☐ **Basic French, Part B.** 18 cassettes (25½ hours) and 300-page text, $149.

(Conn. and N.Y. residents add sales tax.)

Shipped in handsome library binders.

TO ORDER, JUST CLIP THIS AD and mail it with your name and address, and a check or money order. Or, charge to your credit card (American Express, VISA, MasterCard, Diners Club) by enclosing card number, expiration date, and your signature.

The Foreign Service Institute's French course is unconditionally guaranteed. Try it for three weeks. If you're not convinced it's *the fastest, easiest, most painless way to learn French*, return it and we'll refund every penny you paid. Order today!

Many other FSI language courses also available. Write us.

audio-forum®

Audio-Forum
Suite A-69
On The Green
Guilford, CT. 06437
(203) 453-9794

Or visit our New York sales office: 145 E. 49th St., New York, N.Y. 10017 (212)753-1783

Send me Burpee's free 1983 garden catalog!

I want your full-color garden catalog describing more than 1,800 vegetable seeds, flower seeds, trees, shrubs, bulbs, and garden aids. (If you ordered from Burpee in 1982, your new Catalog will be sent to you automatically in January.)

Since 1876, Burpee has been developing new vegetable and flower varieties that are easier to grow *and* more productive. Your satisfaction is guaranteed or your money back. Special discount for ordering early.

Burpee®

W. Atlee Burpee Co.
2673 Burpee Building
Warminster, PA 18974

Name ____________

Address ____________

City ____________ State ______ Zip ______

©W. Atlee Burpee Co. 1982

Burpee Seeds
1983

A Home Computer Primer

In this gift-giving season, a guide through the electronic jungle

by Antonia Stone

The age of personal computers is upon us—and unavoidable during this season of gift buying and gift selling. Advertisements urge us to buy computers for the home, for business, for schools. These electronic marvels apparently can educate us, do our taxes, play games with us, and make us better bridge players. Computers have not yet appeared that can walk the dog, but from the barrage of ads you do get the sense that owning a computer somehow makes you a better person. Suppose that you decide to take the plunge and buy a computer for the family—or yourself. Just what do you need, and what can it do for you?

It would be nice to be able to answer those questions quickly and clearly, and to be able to add that the major home computers can be rated A, B, C, D and that the obvious one for you to buy is X. Unfortunately, a multitude of things must be considered before you can make a sensible choice.

A personal computer (also known as a home computer or a microcomputer) is a great deal more than a game machine. Unlike a terminal, it is not hooked into some giant computer system miles away. It is complete in itself and requires only the electric current that would light a hundred-watt bulb, yet it has many of the same capabilities of a remote giant.

A computer is a tool used to perform tasks that people could perform for themselves if they had the time. (The calculations necessary to steer a spaceship to the moon could have been done with a pencil and paper over several million years.) Because of the high speeds at which they operate, computers make practical certain heretofore inconceivable tasks. A computer also allows high-speed access to various kinds of information on demand, and can be interactive, relating your queries or responses to preprogrammed sequences of questions and answers. Lastly, a computer can be a medium for creative endeavor. This potential, accessible more often to the young than to those of us who are set in our ways, is probably the most important, for we do not know all the ways these machines can be put to use.

Before it can serve any practical purpose, a computer needs three components: a device for feeding information into the computer (input), a component for handling that information (central processing unit, or CPU), and a device for giving the results back to the user (output). All these items are called hardware.

Every home computer arrives with some sort of keyboard. Some have a full-sized, standard typewriter keyboard. On others, the keyboard is smaller, and nonalphabetical keys appear in nonstandard positions. Some computers have touch panels rather than keys.

Many home computers do not include any output device in the initial package. The buyer is expected to have a color television set, or preferably two so that one will be available for exclusive use with the computer. Cables for attaching a newly acquired computer to the TV are usually included with the initial purchase, as are manuals that explain, with varying degrees of clarity, how to hook up the computer and some of the things that can be done with it. These manuals, along with all explanatory material accompanying computer purchases, are referred to as documentation. All input devices (except the keyboard) and all output devices are usually sold at extra charge.

Suppose that you have bought a computer and hooked it up to your TV. What can you do with your new acquisition? When you turn it on, the screen will light up and some writing will appear. At this point, type anything you like on the keyboard, but unless you are extremely lucky, like the monkeys who eventually typed the Bible, nothing will happen except that whatever characters you typed will appear on the screen. In order to communicate meaningfully with a computer, you must speak its language. And its basic language, in the case of all home computers, is called Basic.

Learning Basic, like learning any language, can be a time-consuming task. Basic has a vocabulary (the words are similar to English words and the vocabulary is small; a sophisticated version of Basic contains only about 350–400 words) and a syntax. It is the syntax that makes for trouble. Every typed word of Basic has an exact meaning and must be used in a specified construction; there are no nuances, no inflections. By following your manual carefully or by typing in preconstructed programs from computer books or magazines, you may be able to achieve some slight degree of communication with your computer fairly quickly. For example, you may be able to teach it to accomplish a small task for you, such as printing your name on the screen, telling you what two times seven is, or even printing out the interest on your tax-savers certificate. If you can make it do anything at all, you may become addicted and, from your family's point of view, turn into a computer hermit. Once you're hooked, hours can fly like minutes, meals can be forgotten, and the woes of the world can disappear while you sit in front of the screen learning to program—to communicate with your machine. But the realities of life may intrude and make it necessary to save this blissful experience for an evening, a weekend, or a vacation. What are you going to do with your machine in the meantime?

You will need to buy some programs—recorded sets of instructions to the computer. Also known as software, these programmed instructions can teach your

"It's life as usual in the big wildlife reserve nearby," says Orval Fouse, Supervisor, Utilities & Environmental Engineering at Gulf's Port Arthur, Texas, refinery. "The snow geese still spend a few months here each year during migration. The marshes around the refinery are still full of raccoons, otters, minks, muskrats, even some deer and bobcats.

"To me, that's very good news, because it means they're totally unaffected by the fact that, for the past 20 years, we've been refining what's called 'sour crude.'

"We call it sour because it contains a lot of pollutants. We have to take some sour crude when we buy oil overseas. Of course, we can't release those pollutants into the air. So Gulf spent millions of dollars modernizing this refinery to handle this type of crude. For 20 years now, we've been refining over 100,000 barrels of sour crude a day, and as you can see by the wildlife around here, the air quality is as good as ever."

We have prepared a brochure, "In Search of Balance," on the ways and means of balancing energy and nature. You may have a copy, free, by writing to Mr. William E. Moffett, Vice President, Public Affairs, Gulf Oil Corporation, Department SG, Box 1166, Pittsburgh, Pennsylvania 15230.

Gulf

Gulf people:
energy for tomorrow.

© Gulf Oil Corporation 1981

"Can oil and wildlife mix? They do at Gulf's Port Arthur refinery."

Snow Goose (C. Caerulescens),
photographed near Gulf's
Port Arthur refinery
by Dr. John Tveten.

computer to play tick-tack-toe with you or to guide you through your morning warm-up exercises. Software is available on tape, on disk, and on cartridge. Unless the computer you have purchased takes cartridge software, you will need a disk drive or a tape recorder (items known as additional hardware or peripheral hardware). No ordinary tape recorder will do; you must buy one built for use with your machine. A tape drive is less expensive than a disk drive but is much slower: a disk can contain up to forty programs, any one of which can be loaded into the computer in seconds, while a tape normally contains a single program and takes several minutes to transfer its information into a computer. Cartridges are instantaneous, combining the loading device and the software in one unit.

Every computer has two kinds of memory: memory cells called ROM (for read only memory), the contents of which are accessible only to the machine; and memory cells called RAM (for random access memory), accessible to the computer operator for storing and using software. Computer memory cells are counted in thousands (K), and every computer comes with a certain number of ROM and RAM built in. Some have 4K (4,000) memory cells, some 16K or even 48K. These figures refer to RAM and indicate the software that your machine can accommodate. Unlike a tape recorder, which plays music while the tape is running, a computer runs an entire tape and stores the contents in memory before it starts "playing" the program. Every piece of software is labeled with the number of K required to run it on the computer. If your computer has only 4K and you want to use a program that requires 16K, you must buy a memory expansion device. An advantage of cartridges is that they become part of the computer when plugged in and do not need to transfer their program to the computer's memory. Nevertheless, even software purchased in cartridge form may require more memory than your machine has.

The kind of software you want to use should to some extent determine the brand and model of computer you should buy. Phonograph records can be played on any record player if the speed is correct, regardless of the manufacturer or model number of the phonograph. This is not yet true of computer software. A program written to be used on one computer cannot be used on another brand and, in some cases, cannot even be used on a different model produced by the same manufacturer.

Fortunately, a fairly wide selection of software is available for almost any machine. Games, educational programs, programs that turn your computer into a word processor, programs for accounting, filing, and record keeping, and even programs for teaching you programming can be purchased for amounts ranging from about ten dollars to several hundred dollars, depending on the complexity of the program and the documentation. You may not be able to buy Pac-Man for every computer, but a suitable equivalent called Munchman or Eat-em-up or Nab-em will be available. There will be a version of chess (or checkers or Othello) for sale, but the quality of the computers' game-playing skills varies.

One item of software is not currently available for every machine and yet is important enough to merit the consideration of all potential computer owners, particularly those concerned with the creative aspects of computing. Called Logo, this program teaches you a computer language and at the same time teaches you about the structure of computer languages and the structure of language in general. Originally designed for use with very young children, Logo emerged from a study of artificial intelligence conducted over a period of ten years by an MIT team under

Popular Home Computers

Price Category	Model	Random Access Memory	List Price*	Software	Monitor	Peripherals
UNDER $100	Timex/Sinclair 1000	2K–64K	$ 99.95	cassette tape	black-and-white TV	A
$100 TO $400	VIC-20 (Commodore)	5K–32K	$ 299.95	cartridge, disk, tape	color TV	A–F
	Atari 400	16K	$ 299.95	cartridge, disk, tape	color TV	A–F
	TI 99/4A (Texas Instruments)	16K–48K	$ 299.95	cartridge, disk, tape	color TV or monitor	A–F
	Color Computer (Radio Shack)	16K–32K	$ 399.95	cartridge, disk, tape	color TV or monitor	A–E
$400 TO $1,000	CBM 64 (Commodore)	64K+	$ 595.00	cartridge, disk, tape	color TV	A–E
	TRS-80 Model III a)	4K–64K	$ 699.95	disk,tape	black-and-white monitor built in	A–D
	b)	16K–64K	$ 999.95	″	″	″
	Atari 800	16K–48K	$ 899.00	cartridge, disk, tape	color TV	A–F
	PET 4016 PET 4032	16K 32K	$ 995.00 ″	disk, tape ″	black-and-white monitor built in	A–D ″
OVER $1,000	IBM PC	16K–544K	$1,265.00	disk, tape	black-and-white or color TV or monitor	A–F
	Apple II	48K–176K+	$1,530.00	disk	color TV or monitor	A–F

*Includes keyboard, processor, and minimum memory as specified in previous column. Manufacturers and dealers are offering substantial reductions; even list prices can change from week to week.

Peripheral Code:
A: Tape drive
B: Disk drive
C: Printer
D: Modem
E: Game controllers
F: Miscellaneous others such as voice synthesizer, music keyboard, drawing tablet, etc.

the leadership of Seymour Papert. Only in the last year and a half has it become available to home computer owners. During this short time, its preeminence among programs has been widely recognized. The sales of microcomputers for which Logo is available have jumped, while manufacturers of other machines have been frantically commissioning their own versions.

Perhaps the best source of information about the philosophy behind Logo and its development is Dr. Papert's own book, *Mindstorms* (Basic Books, 1981). But certainly the best way to come to an appreciation of the depth and power of the program is to use it. The student learns by teaching a "turtle" how to move about the screen. The turtle actually looks more like an arrowhead than a turtle, and when it moves it draws a line behind itself so you can see exactly what it has done. The first command you must give the computer is "Tell turtle." The computer then knows that what will follow are instructions for the turtle to do something, such as to move forward forty units ("Forward 40") or to turn to the right or left. The turtle executes each command as soon as it is entered, so the results are immediately visible. You can tell the turtle to repeat one sequence of commands a certain number of times. You can also make up a command for the turtle. Say you type the command "Dance," which is not in the turtle's vocabulary. You will get this response: "Tell me how to dance." You can then type "To dance," followed by a series of regular turtle commands. The turtle will then execute this series of commands whenever you type "Dance." You have created part of the language yourself. Accomplished Logo programmers can create languages to make their own arcade games or to simulate the life cycle of the butterfly. To buy a computer that lacks the ability to run a Logo program would be a serious mistake.

Another potential use that should influence your choice of machine, and will necessitate the purchase of peripheral hardware, is word processing. If anyone in your family does a fair amount of writing—and this includes children who must write compositions and papers for school—a word processor is a marvelous tool that cuts the drudgery of rewriting, error correcting, and recopying. Although word processing exists for almost all home computers, programs vary considerably in ease of use and even in the kinds of tasks they will accomplish. Most will arrange text so that both the left and right margins are aligned, but only some allow for text to be centered on a line. Almost all have a

THE MOORE COUNTY NEWS
Five Contestants Have Entered In The Former Queen Contest
DISTILLERY PROP. INC. TENN.
WHISKEY

If you'd like subscription information on this little paper, drop us a line.

A MAN can read the Moore County News in just five minutes. That's all it takes to keep up with Moore County.

Occasionally, you'll see a piece on Jack Daniel's Distillery. Like when Jack Bateman broke his arm rolling barrels to the warehouse. Or when Frank Bobo (our head distiller) had his grandson born. But normally we don't make the paper much. You see, we've been charcoal mellowing whiskey here at Jack Daniel's since 1866. And according to the editor, there's no news in that anymore.

JACK DANIEL'S
Old No. 7
Tennessee
WHISKEY

CHARCOAL
MELLOWED
DROP
BY DROP

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery
Lem Motlow, Prop., Inc., Route 1, Lynchburg (Pop. 361), Tennessee 37352
Placed in the National Register of Historic Places by the United States Government.

the Museum Shop

Flying goose sculpture is hand cast and mounted on a marble base. Perfect for home or office. Sculpture is 9¼″ wide and stands 7¼″ including base. $60.00 (4.50 P/H)

Voices of the Loon

"Voices of the Loon." This record is published by the North American Loon Fund and National Audubon Society. $9.75 (2.00 P/H)

Members are entitled to a 10% discount on the price of the merchandise.

Please send me ________ records and/or ________ sculptures. I enclose a check payable to the American Museum of Natural History for $ ____________ (NY res. add sales tax.)
Or charge to: ☐ MASTERCARD ☐ VISA
Acct No: ____________
Exp. Date ____________
Signature: ____________
Name ____________
Address ____________
City ____________
State ____________ Zip ____________

The Museum Shop • American Museum of Natural History
Central Park West at 79th Street • New York, New York 10024

"search and replace" capability that allows you to correct, in one operation, the spelling of a certain word wherever it appears throughout the text. Very few word-processing programs enable you to underline. Some allow you to ask the computer for a list of available commands; others have no such mechanism, so that you must either memorize the commands or refer constantly to the instruction booklet. Because of memory limitations, programs vary as to how much text you are allowed to work on at a given time.

All word-processing software requires the use of some sort of printer to deliver the finished product. Printers range in cost from about $300 for a small dot-matrix machine that prints letters as a series of dots to $3,000 or more for professional-quality printers with interchangeable type styles and sizes. Programs can be obtained for as little as $30 and as much as $500. Some come on tape or disk, but some require the installation of additional circuitry in your machine, in the form of a new chip (chips are the building blocks of computers). When planning for a home computer, you should investigate the word-processing programs available, see them demonstrated, and be sure you know the costs of all the extras you will need (don't forget paper).

Other kinds of software that you may want to investigate before buying a particular machine—not just to insure that the quality of the program suits you but also to determine what, if any, additional hardware will be required—include financial planning programs, file-creation programs, picture painting programs, and music writing programs. Almost all home computers have some sound-generating component. The quality varies—from clicks and buzzes to multiple musical lines that enable you to create harmonies to actual speech synthesizers. Some are built in, others must be purchased separately.

Most people will want some games for their computers. Fortunately, the choice here is broad, but once again, additional hardware may be required. Most fast-action games, such as the ubiquitous Pac-Man, require a device called a paddle, or joystick, used to guide the little creature around the screen. Some games are programmed so that the creatures can be guided by means of certain keys on the keyboard. A few teachers who have supported the arcade-style game as a way of developing eye–hand coordination (with special benefits for children with dyslexic tendencies) have commented that keyboard manipulation is more constructive than joystick use, but not all game software allows this alternative.

The arcade type of game is perhaps the sort most commonly associated with computers. While you may not want to turn your home into a video arcade, such games are notoriously addictive, and if you buy one for your computer, the chances are that it will be the most popular piece of software you have, for a time at least. A new program on the market offers such an addict a way to put his or her passion to more creative use. Arcade Machine, after presenting a standard shoot 'em up, entices users into making variations of their own. This program has options for redrawing and animating screen characters, altering paths followed, re-creating background scenes, and making an original title page. With this piece of software, the creation of a new game could become a fascinating family project.

Other games fall into the adventure category. Adventure games provide mental exercise and can be regarded as cultivating problem-solving skills. A typical adventure starts when the screen announces "You are on the front porch. There is a door, and in front of the door, a mat." It is then your move. You type in "Open the door." The computer replies "Use one- or two-word commands, please." You type "Open door." The computer replies "The door is locked."

You: Unlock door.
Computer: I don't have a key.
You: Lift the mat.
Computer: Use one- or two-word commands, please.
You: Lift mat.
Computer: OK. Under the mat there is a brass key.
You: Unlock door.
Computer: I don't have a key.
You: Pick up the damn key!
Computer: Use one- or two-word commands, please.
You: Pick key.
Computer: I don't understand.
You: Take key.
Computer: OK.
You: Unlock door.
Computer: The door swings open and slams shut behind you. You are in a foyer. . . .

The stated object of the game is to accumulate treasure and then escape. The challenge is to figure out which words will produce the desired results. It is a game of logic and language. Variations abound; the more sophisticated include pictures of the surroundings and accommodate a wide range of acceptable instructions from the player. Adventure games tend to inspire cooperation rather than competition.

Other computer games are modeled on standard board or card games such as checkers, poker, or chess. The only advantage afforded by having these games available for your home computer is that you can learn the game and even develop skill and strategy on your own with no one glaring or laughing at you or pointing out an error you have made for the thirtieth time. The mechanical patience of the computer can be, at times, a distinct plus.

A last category of games could be described loosely as educational. The quality of educational software varies tremendously, and bad educational software can do real harm. If one of your principal purposes in buying a home computer is to enhance your children's education, you might want to consult with their teachers. If the school cannot be helpful, here are a few guidelines:

1. Avoid educational software that merely reproduces on the computer screen material that is accessible in a text or workbook.
2. Choose programs that offer a variety of levels, so that once your youngest is finished with first grade, you can still use them.
3. Try to find programs that use the special capabilities of the computer to enhance either the educational content or the process of learning by couching the material in a game context or by using the graphic and sound features of the computer to present material in a way that a book cannot.

For example, a new and imaginatively programmed educational game called Rocky's Boots is designed to teach concepts of Boolean logic to five- and six-year-olds, but can be enjoyed and used to advantage by those considerably older. Very loosely modeled on an adventure format, and with complete instructions incorporated into the game, Rocky's Boots leads you through the process of building an electronic machine. You move from room to room, picking up objects, turning switches on and off, encountering AND connectors and OR connectors and a variety of other useful gadgets. When you have met them all and learned how to use them individually, you are challenged to build a particular machine for a particular purpose. A single experience of Rocky's Boots will provide you with a standard against which to measure other educational software.

With some idea of what the possibilities are and of what you want, which computer should you buy? Both the prices and the capabilities of machines vary considerably. The prices mentioned below are indicative; ongoing price wars mean that large discounts are often available to careful shoppers.

For the Timex machine, clearly the cheapest computer, little software is as yet available; it is mainly useful for experimenting with programming. In the $100–$400 category, all four machines are relative newcomers. The VIC-20, manufactured by Commodore, made its appearance in January of 1981 and has gained a public, probably because of its low price and its color and sound capabilities, so software availability is growing. The VIC's small screen and small memory are drawbacks, however.

The Atari 400 has been upgraded since its initial appearance, so that the purchase price includes 16K of memory rather than the original 4K. The 400 is a cartridge machine, but unlike most other computers, it needs a cartridge even for Basic programming. Another disadvantage of the 400 is its keyboard, which is not a keyboard at all but a touch panel. Many adults find this disturbing because they are accustomed to the feel of keys, and children find the touch panel frustrating because it is so easy to touch the wrong spot. While no Logo program is yet available for the Atari (rumor has it that one will be soon), there is a program called Pilot with Turtle Graphics that, although more cumbersome and less direct than Logo, is an adequate temporary substitute.

The Radio Shack Color Computer has also been upgraded from 4K to 16K.

THANK GOODNESS FOR FLANNEL SHEETS!

Suddenly I'm A Celebrity...

Who ever would have thought that I'd be getting letters from folks all over the United States and Canada too? But that's exactly what's been happening here at Agatha's Cozy Corner!

It seems everybody wants to know more about the old-fasioned cotton flannel sheets I discovered one winter night in a castle on the English moors.

There was a gentleman who thought they sounded like the kind he remembered years ago at his grandmother's house. Several mothers wanted me to rush sets to their children in college because their dormitories were freezing cold. And so many who just like that idea of really fine quality flannel sheets and pillowcases for chilly nights.

I recommend these sheets without reservation. The first time I slept on 100% English cotton flannel I was visiting a 13th Century castle on the moors in Yorkshire. The weather was so cold and bone chilling I really expected to be miserable at night.

You can imagine my delight when soft and fluffy sheets kept me as warm as toast—even in that drafty 13th Century castle! . . . The flannel sheets we have at Agatha's Cozy Corner are the very same kind—lightweight and downy, yet heavenly warm and snug. Because they're 100% pure cotton, they feel better than any of the blends you find in stores. What a great way to save on heating costs at night and still feel rich and special.

Agatha's Cozy Corner has wonderful down comforters and some other special things too. I'll be happy to send you my catalog. It's printed in full color, and gives you the pictures and story of everything we sell. Send for your FREE copy today.

AGATHA'S COZY CORNER
DEPT. NH112
Woodbury Plaza
Portsmouth, N.H. 03801

YES! I want to see the exciting 100% pure English cotton flannel sheets and other specialties of Agatha's Cozy Corner. Send my FREE catalog today.

PRINT NAME
Address
City
State Zip

© 1982, Agatha's Cozy Corner

Indiana
USA 20c
Cardinal & Peony

LIMITED
QUANITY
SELECT
STOCK

ACTUAL SIZE OF FRAME 16½" × 14½"

EACH STAMP IS A MASTERPIECE IN MINIATURE

This pane of 50 State Bird and Flower Commemorative Stamps is one of the most important philatelic items ever to be issued by the U. S. Postal Service. A magnificent gift for anyone interested in birds, flowers or stamps. Limited production quantity guarantees excellent investment potential. The 50 uncancelled 20-cent stamps are mounted under glass and can be removed. Each beautiful wall hanging is accompanied by a brief history of the stamps and artists.

Choose red, green, blue, yellow or white mat board for accent.

If four panes are ordered, an entire mint sheet will be sent including lower left, lower right, upper left and upper right panes each mounted in a separate frame.

$49.95 each plus $2.50 shipping.

NAME ______________________
ADDRESS ______________________
CITY / STATE / ZIP ______________________
Mat Board Color: (check one) ☐ RED ☐ GREEN ☐ BLUE ☐ YELLOW ☐ WHITE

Send Check Payable To:
A CERTAIN
PANACHE
P. O. BOX 456, LORTON, VA 22079 ©

New Natural Way To Sleep

Pure Cotton Knit

Tee-PJ's resemble a T-shirt, but over a foot longer. Special knit gives when you move, eases up when you relax. No bind, no bunch, no chafe, no buttons, no ironing! Most comfortable sleeper you've ever worn or money back (Great for Ladies, too). Choose snow white or soft blue. S-M-L-XL (to ensure best fit include height-weight when ordering.) Order NOW, while prices include postage/handling!

$12 ea **3 for $28**
Long sleeve style (not shown)
$15 ea **3 for $38**
WITTMANN TEXTILES
Dept. 451, Hobe Sound, Fla. 33455

BURMA-LAOS

Travel with Journeyworld to remote corners of the world; Vientiane city of sandalwood, Luang Prabang on the Mekong, the pagoda studded plain of Pagan, Mandalay on the Irrawaddy. Surprising architecture and scenery is the backdrop for a tranquil life-style untouched by the modern day world.

For information call us or your travel agent:

JOURNEYWORLD
155 East 55th St., New York, NY 10022
Tel:(212)752-8308

Rent Mother Nature

Lease A Sugar Maple Tree Or A Sap Bucket For One Year

A really different Christmas gift idea. First, we'll send each lucky friend, in time for Christmas, a gift Announcement Card from you—and a copy of an authentic 1890 Treasury Dept. Lease, hand-personalized, and suitable for framing. Then, in Spring '83, when all the sap has been gathered and processed, each tree tenant will receive a big, decorated jug filled with at least 60 ounces of 100% pure Maple Syrup—30 ounce guarantee to bucket tenants—even more if Mother Nature yields an abundant supply! We do all the work—your friends get the delicious natural syrup—and you get all the raves!

Tree Lease $25.00 or Bucket Lease $15.00
Send check plus $3.00 handling per gift to
NORTH COUNTRY CORP. Dept. NC 113.
Box 193, 106 Appleton St. Cambridge, MA 02138
Include full name and address of gift recipient.
VISA and Mastercharge Accepted With Expiration Date
To order by phone call (617) 893-9000

While there is a new version of Logo for this machine, the library of software is still small. The Color Computer has not been discounted as heavily as others in this category, and its disk drive is among the most expensive.

With its standard, albeit small, keyboard, built-in Basic, and cartridge capability, Texas Instruments' 99/4A is the top entry in the low-price category. Since this machine first appeared on the market as the 99/4, the keyboard has been restructured and an extra piece of equipment produced that can house much of the peripheral hardware. While the software library for the 99/4A is still small, one of the best Logo programs was designed for this machine (although it requires purchase of extra memory). Other factors in its favor are that all of the energies of the computer division of Texas Instruments are—so far—concentrated on this machine (they market no other) and that the company is publicly committed to compatibility of software among future models.

In the $400 to $1,000 range there are also four entries, but the Commodore CBM 64 is too new to be reported on at any length. Although a Logo program has been announced, the quantity and quality of other available software has not been determined, nor has the CBM 64 been through an extended shakedown period of public use.

Two machines in this category (Radio Shack's TRS-80 Model 3 and Commodore's PET 4000) are markedly different from the others. Each has a built-in screen included as part of the purchase price (so adjust your feelings about that price accordingly), but that screen delivers only black-and-white (or gray-and-green) images. These computers are the old guys in the market, so there is considerable software available in almost every category, but no Logo for either one. Still entirely appropriate for the school market because of the software library available and the ease of use in an educational setting, these machines are not competitive with newer computers for the home market.

This leaves the Atari 800 on top by default, but it is in any case a good machine. Unlike the 400, the 800 has actual keys in a standard configuration. You still need a Basic cartridge before you can program in Basic, but the graphic and sound capabilities of the machine are excellent, and the software selection is extensive. Rocky's Boots, for example, should be available for the Atari by Christmas, and Atari has one of the most delightful picture-painting games called, appropriately, Paint.

The new IBM Personal Computer, in

the top-priced category, is a good candidate for the home if you are planning a great deal of business use. The price is high for the beginner, and there is not yet much software slanted toward home use. The other entry in the higher price range is Apple, made by the best-known home computer company. The story of the design of the first Apple computer in a garage has become legendary in the history of free enterprise.

Why should you buy an Apple, which costs $1,100 to $3,500, rather than some considerably less expensive home computer? The purchase price of an Apple includes 48K of RAM. Even the use of Logo does not require the purchase of extra memory—and there are three versions of Logo for Apple. The catalog of Apple software is so thick that it has to be subdivided for easier handling, and Apple continues to develop high-quality software. The programs Arcade Machine and Rocky's Boots were first developed for Apple. Also, a fine collection of software called Discovery Games is being written for Apple by the Children's Television Workshop.

The Apple Company discourages purchasers from using the tape drive and is promoting only the disk. The Apple is not constructed to accept cartridges, but it does have a kind of substitute. Cards can be purchased separately and inserted into the body of the machine to expand its capabilities to include other languages, sound synthesizers, and other things. The Apple is truly a versatile machine. It is not perhaps as immediately accessible for programming as the Commodore PET, but it does offer the computer hobbyist a hardware design that facilitates creative use.

No machine can provide everything one might want from a home computer. Even if you decide to pay the price and get an Apple, you may find yourself lacking an option available on another machine. Some buyers will pick the lowest-priced machine and wait for its software market to expand, while others will take a middle course by buying a Texas Instruments computer and all of the peripheral equipment necessary to bring it to its most sophisticated state.

No matter what decision you make, it is important to find someone who will advise you honestly about your machine, help you find software, and give you service when the inevitable malfunctions occur. If you are lucky, you will find a creative and cooperative dealer. These rare creatures really know the machines they sell, inside and out. They are computer buffs themselves and want you to be happy with your machine. They know the software and will not only help you select what you really want but will also sometimes even help you create and market your own. Some offer classes in computer operation or programming. The rarest will give you their home telephone numbers, teach you how to make simple repairs, and, if something catastrophic happens, give you a new machine and send your wreck back to the company.

You should know, too, about a wonderful madman named Russ Walter, author of a series of books called *The Secret Guide To Computers*. In these books, which are entertaining as well as useful, Walters gives his telephone number and claims he will answer any call at any hour of day or night from someone who has a computer problem. You pay only for the call. Another source of free advice is a company called Vital Information, Inc., which publishes software handbooks and backs up its claim to the name by offering a toll-free number that computer users may call for up-to-date software information. The number is (800) 255-5119.

You should also make contact with a user's group in your area. There are Apple user groups, PET user groups, and user groups for machines that I have not mentioned—in fact, there are groups for virtually every computer. There is almost no better source for practical advice about your computer.

One final suggestion: If you cannot afford the going prices for commercial software, write to Ann Lathrop or Leroy Finkel at Softswap, c/o The San Mateo County Office of Education, Redwood City, CA 94063. These two energetic and devoted people have collected a vast library of public-domain software for many of the major home computers. Ask for a catalog. You can get disks or tapes from Softswap; fifteen programs may run $10 plus postage. You may not like everything you get, but you can at least have fun trying to change it into something you like better.

If all this sounds complicated, it is, but not incredibly so. If you decide to enter the new world of home computers, you will find plenty of people you can rely on and places you can go for help when you need it. And the ultimate pleasures far surpass the unpleasantness of temporary bewilderment. You will have a magnificent tool that makes possible new forms of exploration, creativity, and enjoyment.

Antonia Stone is founder and executive director of Playing to Win, Inc., a New York-based nonprofit organization that promotes development of computer skills among the socially disadvantaged.

SOUTH AFRICA

**A world
in one country.**
Expect the unexpected. Abundant varieties of fauna, flora and peoples.
A rich land, unspoiled and beautiful.
For an unforgettable vacation experience, consult your travel agent or ask for your free color brochure, 'South Africa – Gateway to a Continent'.

South African
Tourist Corporation,
610 Fifth Avenue,
New York,
N.Y. 10020.
Tel. (212) 245-3720.
Telex 649535.
Name__________

Address__________

NH-1182

**Where summer is
four seasons long.**

satour

THE MARKET

Antiques

EARLY SCIENTIFIC INSTRUMENTS. Send $3 for fully illustrated fall catalogue of antique microscopes, telescopes, sundials, surveying and navigation instruments for sale. Tesseract, Box 151-H, Hastings-on-Hudson, NY 10706

Art

AMERICAN INDIAN CRAFTS: Southwest Indian pottery, baskets, rugs, kachinas. Northwest Coast Indian masks, totems, graphics, Eskimo sculpture. No catalogue One-of-a-kind pieces, individually photographed Priced $100/up. Photos and data available. Specify interests. Box 5896, Sherman Oaks, CA 91413. (213) 789-2559

ANIMAL STAMPS—MORE! Elegant transparent stamps. Use inks, dyes. Grand Christmas gifts. Catalogue, instructions $3.00. Aardvark, 1191 Bannock Street, Livermore, California 94550

"CELTIC WOLVES" the lost wolf of ancient Irish art in a signed, numbered cibachrome print by Giovanna Fregni. $50 to S. Alles Blom, 2713 W. McKinley Blvd., Milwaukee, WI 53208

EVERY NAVAJO WEAVING IS A LIMITED EDITION of one. Brochure and descriptive price list of our fine contemporary Navajo rugs and tapestries, $2.00. Guards' Navajo Rugs, 2625 Desert Drive, Las Cruces, NM 88001 (505) 526-3831

FEDERAL/STATE WATERFOWL STAMP Print Specialists. Excellent inventory. Write or call (503) 343-9255 for informative newsletter. d'Lou Wildlife Galleries, 2769 Emerald, Eugene, OR 97403

FOR AN AUTHENTIC COAT OF ARMS in your family name, write Athol Heraldry, Box 9, Athol, MA 01331. The perfect Christmas gift!

GAJESA (Bushy Head) Iroquois Mid-winter Festival Mask, $48, request photo, McCoy Imports, Liberty, NY 12754

INDIAN AGATE BEADS, illustrated history by Peter Francis. $8.00. Cornerless Cube, Riverside Drive, Lake Placid, NY 12946

PLAINS INDIAN ART & ARTIFACTS: Free catalogue shows painted shields, mounted trophy buffalo skulls, war arrows, peace pipes, chokers, breast plates, war clubs, horse dance sticks, star quilts and more. Exclusive source. Handmade with traditional tools and authentic materials. Many have interesting stories to tell from Cheyenne, Sioux and Blackfoot heritage. Collector's items, unique gifts and stunning decorations. Write or call: Prairie Edge, P.O. Box 8303, Dept. K, Rapid City, South Dakota 57701 (605) 341-3620

RUBBER STAMPS of nature. $1.30 for catalogue of your favorite wildlife. Nature Impressions, 1007 Leneve Place, El Cerrito, CA 94530

Back Numbers

NATIONAL GEOGRAPHICS 1888-1982, issues Book Publications, Collectors Items, Send Wants Buxbaum Geographics, Box 465-NH, Wilmington, DE 19899

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHW, 84 Fifth Avenue, New York, NY 10011

Books

BOOKFINDING LIBRARIANS locate any subject or title, 150,000 different titles in stock, indexed by author, subject & title. PAB, 2918 Atlantic Avenue, Atlantic City, NJ 08401 or (609) 344-1943

DISCOUNT BOOKS—20% OFF; e.g. Andrews' "The Flight of the Condor" (list $22.50) only $18.00 Most books available. Free brochure. Add $1.25/title shipping (plus 5% in MD). Earthworks/NH, 8135 Ball Rd., Frederick, MD 21701

PUBLISHERS' OVERSTOCKS

All publishers — all subjects: art, history, biography, fiction, and much more. The most complete catalog of bargain books available anywhere! Write for your FREE copy:

Hamilton, 98-55 Clapboard, Danbury, CT 06810

FANTASTIC SHOPPING POSSIBILITIES—New book describes 3667 U.S. Mail Order Catalogues $10.00 + $1.00 postage. Coburn Bookco, Box 13018-NH St Louis, MO 63119

FREE BOOK SEARCH. Also Nature book lists. Write. Smith's Book Service, Rt. 6A, Brewster, MA 02631

LATVIAN MITTENS: Traditional Designs and Techniques, by Lizbeth Upitis features charts, color photos, historical and cultural background. $11.50 ppd. Set of 8 large color postcards of outstanding mittens, $4.50 ppd. Dos Tejedoras, 3036 N. Snelling, St. Paul, MN 55113

YESTERDAY'S BOOKS LOCATED, no obligation. Out-of-State Book Service, Box 3253J, San Clemente, CA 92672 (714) 492-2976

Collectors Items

BIRDS ON POSTAGE STAMPS from many countries. 25 different 35¢ or 50 different 65¢. George Ford, P.O. Box 5203-N, Gulfport, FL 33737

RECEIVE VALUABLE MINERALS MONTHLY! Free Details! Write Today! Mineral of the Month Club, 13057-H California, Yucaipa, CA. 92399

Correspondence

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin, West Germany

PENFRIENDS-ENGLAND-USA. Make lasting friendships through correspondence. Send age, interests. Free reply. Harmony, Box 89NH, Brooklyn, NY 11235

SCANDINAVIAN LADIES, sincere, seek correspondence for meaningful relationships. Details: Scannaclub, Dept. H6, Box 4, Pittsford, NY 14534

SINGLE BOOKLOVERS gets cultured persons acquainted Nationwide. Established 1970. Write Box AE, Swarthmore, PA 19081 or call (215) 566-2132

Education

FREEDOM? Research charter seeking funds. All contributions tax deductible. Leon C. Simpson, 18 First Street, Bangor, Maine 04401

LEARN/PLAY CHESS with more flair . . . with Color/Coded Pieces (patented). Send SASE for poster/info: Iris, P.O. Box 262, Newbury, Ohio 44065

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Big Pay! Transportation! Newest Handbook, $2.00 Australian International, Box 19107-RY, Washington, DC 20036

ENVIRONMENTAL OPPORTUNITIES—Monthly bulletin lists environmental job openings throughout the U.S. Free details: EOV, P.O. Box 450, Walpole, NH 03608

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RY, Washington, DC 20036

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RY, Washington, DC 20036

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . . Intermountain 4Y, 3506 Birch, Cheyenne, WY 82001

TEACH HERE—TEACH ABROAD: School, College openings; USA $5.95; Abroad $5.95. Placement sources: USA $4.95; Abroad $4.95. EISF, Box 662, Newton, Massachusetts 02162

Financial

GET CASH GRANTS—FROM GOVERNMENT. (Never repay). Also, cash loans available. All ages eligible. Complete information, $2 (refundable). Surplus Funds-NH, 1629 K St., Washington, DC 20006

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Swaziland. Sampler: 4/$2.98. Free Brochure. Multinewspapers, Box DE-20A, Dana Point, California 92629

Gourmet Interests

BE DIFFERENT THIS GIFT GIVING SEASON. Send for free color brochure. Louisiana Gift Pack, P.O. Box 2015, Covington, Louisiana 70434

EASY—DELICIOUS—Cheesecake and Mousse recipes. $2.00 to P.O. Box 1290, New Rochelle, NY 10802

GRANDMA'S "CHRISTMAS PUDDING" and other delectable holiday recipes. $2 SASE, "Recipes", Box 440902, Aurora, Colorado 80044

MINNESOTA WILD RICE. $6.00 per pound, prepaid. Five pound minimum. Floura Bros, Box 44C, Blackduck, MN 56630

PACIFIC NORTHWEST. Ten favorite recipes, easy but unique. Send $3.00 to: Puget Recipes, P.O. Box 15901, Seattle, WA 98115

Merchandise/Gifts

BRAZILIAN AGATE CLOCK KIT. Desk/wall, excellent gift, easy assembly. $19.95 postpaid. Forbcraft, Box 434N, Delavan, WI 53115

DOG TAGS FOR YOUR BAGS, cameras, equipment, etc. 4 lines—15 spaces each, 3 tags $11.99. NYS add tax. CMA, 1742 Second Ave., Dept. 200P, NYC 10028. Free brochure #P, (212) 249-1381

FREE CRYSTAL CATALOGUE. Sparkling pendants, earrings, window prisms crafted from 32% full lead Austrian crystal. Free shipping. Give a rainbow for the holidays! For free catalogue: Waterbabies Crystal, NH-11, Suite 41, 2067 Broadway, NYC 10023

FREE, two all purpose greeting cards, spectacular floral prints, with set of 10 cards, envelopes, money back guarantee, send $5.95 plus .75 postage to Willow Branch Cards, 8223 N. Lake, Fox Point, WI 53217

HAND CARVED MAHOGANY, Mayan design bowls, plaques, owls, boxes, office items, tables, free brochure. Artisan Originals, Rt. 1, Box C-24, Flat Rock, Al 35966

IDENTIFY YOURSELF WITH INDIAN HANDMADE silver w/turquoise Lapel Name Tags and/or Sand Painting Desk Plaques in several sizes and styles. For free brochure write: Custom Enterprises, Dept. N2-Box 2997, Gallup, NM 87301

ONYX GEOMETRICAL FIGURES. SPHERE CUBE, etc. Approximately 2" Three for $10.00 plus $2.00 handling, postage. Send check, money order. Geonyx, Dept. NH-10, c/o Box 5066, El Paso, TX 79953

PHOTOS—Full Color—Unique—Attractive—USA, The World, others—8 × 10 inches, suitable for framing. Send $1.00 for full color brochure: FAB Enterprises (2), 58 Sherman Place, Garfield, New Jersey 07026

SCIENCE/NATURE CLUB FOR CHILDREN. Explore wonders of science! Full year's membership includes bimonthly 8-page newsletter, at-home experiments, discounts on science books, official membership badge and more! Year round activities and learning that's fun. Give a gift that grows with a child. Ages 7-10. Send $20 plus child's name and address to: The Universe Club, Dept. NH-11, 23 West 89th Street, Suite 4R, NYC 10024

THE FLYING EAGLE: Finest laser color reproductions of the ultimate Bald Eagle photograph. 12" × 20", $15. Beautiful Eagle Christmas and greeting cards, 10 for $6, 50 for $25. Dr. Hunter, Box 10-888, Anchorage, Alaska 99511

TOP QUALITY WISCONSIN CHEESE cut to order and Gift Boxes. Introductory special 4 lbs. assorted cheese $10. Send for price lists, The Little Cheeseman, Box 194, Fort Atkinson, WI 53538

TRAVEL SECURITY DEVICE—smoke, fire, intruders. Free brochure #N, (212) 249-1381. CMA, 1742 Second Ave., Dept. 200N, NYC 10028

"WARI" GAMEBOARDS. Fine tune your thinking as you play. Quality built in solid mahogany and redwood. Ages 8 to adult. You won't be disappointed. $30.00. Send check or money order to "Wari", 8206 Flower Avenue, Takoma Park, MD 20912

Miscellaneous

IDEAS, INVENTIONS, new products wanted for presentation to industry. Call free 1-800-528-6050. In Arizona, 1-800-352-0458. X 831

Music

COURTLY MUSIC for Weddings or Parties. Elegant, Festive, Baroque and Renaissance Music on Recorders. (212) 580-7234

FREE BROCHURE: Quality solid wood dulcimers and kits. We provide the finest materials and dulcimer parts. You provide the meticulous assembly. No special tools needed. Black Mountain Instruments, P.O. Box 779, Lower Lake, CA 95457

RECORDS-TAPES! Discounts to 73%. All labels; no purchase obligations; newsletter; discount dividend certificates. 100% guarantees. Free details. Discount Music Club, 650 Main Street, P.O. Box 2000, Dept. 25-1182, New Rochelle, NY 10801

Newsletters

NATURE PHOTOGRAPHERS! Stay on top of your markets with The Guilfoyle Report. For information: AG Editions, 142 Bank St., New York City 10014 (212) 929-0959

Old Time Radio

OLD TIME RADIO PROGRAMS on cassette tapes. Free catalogue. Cassette Library Center, P.O. Box 5331H, Baltimore, MD 21209

Optical

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired. Large stock. Orders filled postpaid day received. Birding, Box 5N, Amsterdam, NY 12010

Personals

MEET SINGLES Mexico, Orient, Europe, Australia. Free information. Write: International, Box 1716-NH, Chula Vista, CA 92012

Real Estate

FREE! BIG Fall-Holiday Catalogue! Over 5,400 country properties described, pictured! Land, farms, homes, businesses, recreation, retirement values! Selected best of hundreds of offices All Across America! Strout Realty, Inc., Plaza Towers, Dept. 5390, Springfield, MO 65804. Call toll free: 1-800-641-4266; in Missouri call collect (417) 862-4402

FREE CATALOGUE. Describes and pictures farms, ranches, acreages, businesses and town and country homes from coast to coast. United Farm Agency, Inc., 612-U W 47th St., Kansas City MO 64112. Call Toll-Free: 1-800-821-2599; MO res. call Toll-Free: 1-800-892-5785

GOVERNMENT LANDS... FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00. Lands, Box 19107-RY, Washington, DC 20036

"HOME BUYER'S INSPECTION GUIDE." Save time and Money! A must for the Home Buyer. $4.00. Realty Services, Dept. NH, Box 382, Lynbrook, NY 11563

Rental

LOVELY, WATERFRONT, FLORIDA KEYS ESTATE. 3 acres, tidal pool, dock, swimming area. 2 bedrooms, 2 baths. December thru March, $2,000/month. Pollak, 202 Morton Avenue, Marathon, FL 33050

ST. JOHN, VIRGIN ISLANDS apartment for two. Vacation: swimming, snorkeling, exploring National Park. $350 weekly. Barsel, Box 114, St. John, U.S V.I. 00830

Resorts

CARIBBEAN HIDEAWAY: Very small, very special hotel tucked into a 30 acre plantation on the island of Bequia, St. Vincent Grenadines, W.I. Ten rooms, pool, beautiful beach, snorkeling, hiking, photography, birding, tennis. Write or call: Spring on Bequia, Box 19251, Minneapolis, MN 55419 (612) 823-1202 or your travel agent

KENYA. Attractive cottage at Lake Naivasha. Safaris organized, birders' paradise. $280 per week. Write M. Carnelley, Box 79, Naivasha, Kenya

VACATION/RELAXATION—Birdwatcher's delight—Peaceful, secluded nature lover's mountain retreat. Cave Creek Ranch, Portal, Arizona 85632

Tours/Trips

A BEAUTIFUL EXPERIENCE. Learn sailing aboard 50' ketch 'Palisander'. Winter Caribbean, Summer Chesapeake, Spring & Fall Blue Water Cruises. $600/person/week. Cuttyhunk Marine Adventures, c/o Wailes Gray, 77 Tweed Blvd., Nyack, NY 10960

ADIRONDACK WILDERNESS SKI TOURS: Enjoy the exhilaration and beauty of a northern winter in the company of expert instructor/guides. Cross-country ski vacations are five days, limited to 10 guests, geared to all levels of ability. Daily excursions into "forever wild" Forest Preserve. Evenings spent in cozy lodge enjoying hearty meals, good company, and fireside programs featuring Adirondack naturalists, photographers and conservationists. Write: Adirondack Ski Tours, McMaster Rd., Saranac Lake, NY 12983. Call (212) 546-9202

ADVENTURES WITH WILDLIFE—Whale Watch cruises with gray whales, humpbacks and even blue whales. African photo safaris viewing gorillas in Rwanda, wildlife and birds in Kenya, Tanzania, Zambia, Botswana and Madagascar. New brochure with 24 trips. Adventures International, Dept. NC, 4421 Albert, Oakland, CA 94619

Unusual India & Nepal

Trekking (walking) expeditions to the foot of Mt Everest & Annapurna. Wildlife safaris in search of rare Asian birds and mammals. Explorations of remote Bhutan, Sikkim, Ladakh and tropical Sri Lanka. 10 to 35 day programs from $670.00 + airfare. Free Brochures

Himalayan Travel, Inc.

P.O. Box 481-NH
Greenwich, CT 06830
(203) 622-0055 Toll Free (800) 243-5330

AFRICA AFFORDABLE ADVENTURES. Our own, comfortable, weekly Jet allows fabulous Kenya experiences, at incredible prices, European quality. Example: 17 days $1796, All Included (from USA, stc). Wildlife, People, Safari, Indian Ocean Adventure. Also: Madagascar (Living Fossils), Rwanda (Gorillas), Tanzania, Botswana, Namibia, etc. Request Prospectus: Forum Travel International, 2437 Durant, Berkeley, California 94704 (415) 843-8294

AFRICAN WILDLIFE SAFARI! See and Photograph the Spectacular Wildlife and Scenery of some of the Greatest Wildlife areas in Africa. This Three Week safari (with optional extensions) is led by African Wildlife Authority Dr. Jim Hitchcock. Departures in February and July 1983. Land costs under $3600 per person (estimated 1983 rates). Should see over 400 bird species and most of the larger mammals. Write or call now! All Points Travel, P.O. Box 1269, Nevada City, CA 95959 (916) 272-7241

ART OF ITALY, Scandinavian solar energy, Irish drama, other tours available for college credit through University of Alaska-Fairbanks. 2-4 weeks, modest prices, various points of departure. Special round-the-world Christmas program. Write: Conferences & Institutes, 117 Eielson, UAF, Fairbanks, Alaska 99701

BAJA CALIFORNIA GRAY WHALE EXPEDITIONS on the Qualifier 105 with expert naturalists as leaders. December through March. Elephant seals, sea lions, marine birds, desert island plants, wildflowers and whales for an outstanding natural history experience. Write for free brochure to Nature Expeditions International, Dept. 22NH, 599 College Avenue, Palo Alto, CA 94306

BAJA WHALE-WATCHING. 5 days/4 nights, Scammons Lagoon whale-watching camp, Feb. 14-19, $774. Contact Wilderness: Alaska/Mexico, Dept. NH, 5119½ 27th N.E., Seattle, WA 98105 (206) 522-5315

BECOME A SPARETIME TRAVEL AGENT, detailed guidebook explains how, commissions, travel benefits, $3.95 SAV Travel, Box 571-NH, Hicksville, NY 11802

BEST OF ECUADOR: Most desired Galapagos Cruise, best time of year. February 28 - March 13, 1983. 14-day trip includes historic Quito, Otavalo Market, 8 days in Galapagos on M/V Santa Cruz. Our own expert guides emphasize culture, ecology, birds. Pre-trip option: 3 days on floating hotel in Amazonian Ecuador—Unique. Princeton Nature Tours, 282 Western Way, Princeton, NJ 08540 (609) 683-1111

CARIBBEAN WILDLIFE SAILING EXPEDITION—An Audubon Travel Group vacation with nature. January 10, 1983, 8 days, $555 plus air. Blue Sky Adventures, Oak Ridge, NJ 07438 (201) 697-7233

CULTURES & NATURE: Americas, Africa, Asia, Europe, Egypt. Conventional Adventure, nd Hiking programs. Small Groups/Individuals. Specify interests, countries, dates. Forum Travel, 2437 Durant, Berkeley, California 94704 (415) 843-8294

DESERT ECOLOGY SEMINARS: Rafting on the Rio Grande, backpacking in the Big Bend, caravans to Mexico. Chihuahuan Desert Research Institute, Box 1334, Alpine, TX 79830 (915) 837-2475

EXPERIENCED NATURALIST helps you explore wild Africa, Amazon, Galapagos, and much more. Numerous whale study cruises. Brochure: Biological Journeys, 1876B Ocean Drive, McKinleyville, CA 95521

GALAPAGOS ISLANDS. Economic tours from $1666 including airfare. 4, 5, 8, & 15 days Galapagos, all meals. Options, mainland Ecuador, Amazon, Cuzco/Machu Picchu. University credit available. Joseph Colley, Last, Inc., 43 Millstone Rd., Randallstown, MD 21133 (301) 922-3116

INCAS, MAYAS & IGUANAS: Legendary Peru, Ecuador. Fascinating Galapagos, Amazon, Costa Rica, Mexico, Belize. Small Groups/Individuals. Forum Travel, 2437 Durant, Berkeley, California 94704 (415) 843-8294

JUNGLE VACATION in the Talamanca Rainforest. Superb birding, plant and insect hunting. Riding and hiking trails; guides. Weekly rates $225.00 single; $350 double. M.E. Snow, Apartado 73, 7200 Siquirres, Costa Rica

NATURALIST'S DELIGHT! Baja California, Mexico. Photography! Whales! Birding! Personalized Wilderness Travel from $985. Baja's Frontier Tours, 3683-N Cactusview Drive, San Diego, CA 92105 (714) 262-2003

NEW ZEALAND WALKABOUT: Escorted nature and hiking tours featuring New Zealand's scenic National Parks, plus the Milford Track. Pacific Exploration Co., Box 3042-N, Santa Barbara, California 93105 (805) 687-7282

OCEANOGRAPHIC EXPEDITION: Divers, naturalists needed for reef research project. Vanuatu, Solomons, Papua-New Guinea. Share expenses, chores, sailing. Three 1983 segments begin: June, August, October. Box 1644, Brisbane 4001, Australia

READY TO TRAVEL? Plan ahead with finest maps! $1.00 Catalogue. Eagle Eye, Box 751-N11, Paonia, CO 81428

THE INN WAY by Margaret Zellers. Compact, comprehensive guidebooks about small, family-operated hotels in Austria, Switzerland or Caribbean. Specify area. Send $4.95 per book plus $1.50 postage/handling to Geomedia, Southport, CT 06490

200 YEAR OLD SPANISH RANCH. Unexcelled riding, great birding (200 species), wildlife. Delightful dining, sunshine, quiet. Adjacent to Kitt Peak Observatory, Papago Indian Reservation, Mexican border. Rancho de la Osa, Box 1, Sasabe, AZ 85633

UNIQUE TRAVEL BOOKS! Exploration, nature/wildlife, maps, languages. Free catalogue! Wayfarer Books, Box 1121-NK, Davenport, Iowa 52805

RATES AND STYLE INFORMATION

The following new rates are effective with the January 1983 issue.

$2.00 per word; 16 word ($32) minimum. *Display classified* is $200 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY to: The Market, NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024. Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—1st of the month, two months prior to cover date (the January issue closes Nov. 1). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

Ellis Hughes's Meteorite

This year marks the eightieth anniversary of the discovery of the Willamette Meteorite, the largest ever found in the United States and one of the largest in the world. While most meteorites are shapeless lumps, this 31,000-pound chunk of nickel-iron is pitted with great cavities, some large enough to hold a child. Contrary to popular belief, the pits were not caused by the meteorite's fall through the atmosphere but by centuries of rusting in the damp climate of Oregon.

The history of the Willamette Meteorite is as remarkable as the object itself. In the fall of 1902, a Welsh immigrant named Ellis Hughes discovered an odd, partly buried rock about three-quarters of a mile from his house. The rock lay on a hillside in a dense forest near Willamette, Oregon, on land owned by the Oregon Iron and Steel Company. The next day Hughes brought a neighbor, William Dale, to inspect the rock. After a short examination one of the men struck it with a stone; they were surprised to hear it give off a ringing sound. At first they thought it might be a great iron deposit, but after some discussion they concluded it could only be the exposed tip of a gigantic meteorite. Realizing its value, they hid it under fir boughs and started plotting how they could expropriate it. The best way, they decided, would be to buy the land on which it lay. Since neither had much capital, Dale went off to eastern Oregon to sell some property he owned.

For some unknown reason Dale never returned. After a number of months, Hughes's wife began nagging him to do something about the meteorite before someone else found it, so he formulated a plan: instead of buying the land, he would secretly move the meteorite the three-quarters of a mile to his own property. Assisted only by his fifteen-year-old son and working in great secrecy with the crudest of tools, Hughes began excavating the meteorite in August 1903. After digging around the 31,000-pound mass, he jacked and levered it by hand out of the hole and onto a primitive flat-bed cart that he had built in the forest entirely of logs, with tree-trunk sections for wheels. The resourceful Welshman then rigged up a sort of capstan, attached a steel cable, and sank the device firmly in a cleared section of ground a hundred feet from the cart. As Hughes drove a horse harnessed to the capstan in endless circles, the cable slowly wound up on the capstan, painfully inching the cart forward. Hughes's difficulties were compounded by spongy, soggy ground, on which he was obliged to lay down a roadway of wooden planks. After every hundred feet of progress, which usually took several days, the capstan had to be dug up and moved forward and a new clearing made for the horse.

For three months Hughes and his son labored in this fashion until, in the late fall, the cart drew up to Hughes's house. He immediately built a crude shack around the cart and meteorite. During this time, his secrecy had been so total that his neighbors later said they had no idea something out of the ordinary had been going on.

Hughes then announced his great discovery and threw open the doors of his shack to the public, charging twenty-five cents per visitor. One of his early customers was, unfortunately, the attorney of the Oregon Iron and Steel Company, who somehow discovered (perhaps by following the trail back to the gigantic hole in the ground) that the meteorite had been removed from his company's property. He offered Hughes $50 for the meteorite, which Hughes summarily refused. The lawyer then commenced suit on behalf of the company to recover the meteorite. The case went to court and was bitterly fought by Hughes, who had a deep conviction (no doubt stiffened by his three months of work) that the meteorite was rightfully his.

Hughes's defense was unusual. First, he put several elderly Indians on the witness stand who testified that long ago the meteorite belonged to their tribe. They believed it had fallen from the moon and considered it to be sacred. To insure success in battle, they had dipped their arrow points in the puddles of rainwater that collected in its cavities. In addition, young braves were sent to the stone in the dead of night to undergo initiation rituals. Thus, Hughes argued, the Indians, not the company, had a prior claim of ownership. Hughes also tried to persuade the court that the meteorite had probably not fallen on the spot where it was found. It may have been carried, he said, by the Indians from somewhere else (in particular, from a spot lower down the hillside, where his property was); or barring that, it may have been transported by glaciers. The company, on the other hand, contended that the meteorite was a piece of real estate that Hughes had stolen from them.

The court found in favor of the plaintiff, and the company hitched a team of horses to the makeshift cart and began moving the meteorite. They hauled it as far as the road when, in desperation, Hughes got the Oregon State Supreme Court to issue an injunction against moving it farther while he appealed the verdict. The company left the cart by the roadside and hired a twenty-four-hour guard to prevent its theft.

Meanwhile, a neighbor of Hughes, hoping to catch a piece of the action, was busy blasting a large crater in his land. The neighbor then brought suit against both Hughes and the company, claiming that the meteorite had been stolen from him, and he had the crater to prove it. His suit was promptly dismissed.

On July 17, 1905, the State Supreme Court upheld the earlier ruling and awarded the meteorite to the Oregon Iron and Steel Company. The company wheeled it away to Portland, where it was unveiled with great fanfare at the Lewis and Clark Exposition in a ceremony attended by the governor.

CRUISE

TAHITI

FROM $749 Bali Hai Calls! Depart **Papeete,** and explore the aquamarine lagoons of **Bora Bora, Hauhine, Raiatea, Tahaa** and **Moorea.** Enjoy fascinating shore excursions to discover colorful **villages, resorts,** and **spectacular scenery.** Fly to Tahiti, via **UTA French Airlines,** at special low fares available with the cruise ... and included in cruise tour prices!

BEFORE YOU SELECT ANY SOUTH PACIFIC CRUISE ...REVIEW OUR EXCITING BROCHURE!

PANAMA

FROM $649 Depart **Panama City** and discover the exciting history and colorful culture of the **Crossroads of the Continents! Transit the Canal,** see **Colonial Panama,** primitive **Indian Tribes,** historic **Spanish Main Gold Ports,** plus beautiful **Pearl Islands** and the lush **Darien jungle.** After the cruise, extend your stay with optional interludes at your choice of **world class resorts.** Special low air fares are available with the cruise. **Travel now at our great low prices!**

LOWEST COST DELUXE CANAL CRUISE ...TRAVEL NOW WHILE PRICES ARE LOW!

EXPLORER CLASS™ CRUISING

Both sensational programs feature our unique **Explorer Class™** deluxe cruise vessels, featuring **air-conditioned staterooms** with **private facilities,** picture-windowed **dining room,** comfortable **lounge, bar** and spacious **sundecks.** Ships specially built to travel where no cruise line has gone before ... insuring you of a first-rate cruise experience!
PLAN EARLY...for best price, selection of stateroom and departure date!
To obtain a free, full-color brochure, see your local travel agent, mail this coupon, or **call toll-free:** **1-800-426-0600**

EXPLORATION CRUISE LINES™
1500 Metropolitan Park Building Dept. AJC Seattle, Washington 98101

Please send me your new Cruise and CruiseTour brochures ☐ TAHITI ☐ PANAMA

NAME ____________________

ADDRESS ____________________

CITY __________ STATE __________ ZIP __________

When the exposition closed, a generous friend of the American Museum of Natural History, Mrs. William E. Dodge, bought the meteorite for $20,600 and gave it to the Museum. According to a 1909 issue of the *American Museum Journal*, it was the highest price ever paid up to that time for a specimen for the Museum's collection.

The Willamette Meteorite was the only

Songs of Nature

The Membership Office is presenting *Songs of Nature* on Saturday, November 20, at 11:00 A.M., 1:30 P.M., and 3:30 P.M. in the Kaufmann Theater. The program features the Orpheus Chamber Singers, who will perform songs from many different lands and cultures, including Negro spirituals; sixteenth-century English, French, and Italian songs; songs by Mozart, Debussy, and Purcell; and music from the American Sacred Harp. Throughout the program children will be invited to participate by singing along, clapping, and asking questions. The program is free for members, $2.50 for nonmembers, and tickets are required. Please contact the Membership Office for more information.

Moana

In 1923, filmmaker Robert Flaherty traveled with his family to the South Sea island of Savai'i to make a film about the life and traditions of its Samoan inhabitants. The result of his efforts was the silent film *Moana of the South Seas*. The critic John Grierson wrote: "The film is unquestionably a great one . . . *Moana* deserves to rank with those few works of the screen that have a right to last." Fifty years later, Monica Flaherty Frassetto, Flaherty's daughter, embarked on a project to record Samoan songs, chants, and music and synchronize them for a sound track for the film. Frassetto will introduce the new sound version of the film at a special membership program on Wednesday, November 10, at 7:30 P.M. in the Auditorium. The program is free and open only to members, but advance reservations are required. Write to the Membership Office for ticket reservations.

African Lecture Series

The African-American program of the Museum is presenting a lecture series focusing on black music and religion in America and Africa. The free lectures will take place in the Leonhardt People Center on Wednesday evenings at 7:00 P.M. on November 3, 10, and 17. Programs include *Historical Development of Jazz*, with Leonard Goines and his quintet; *Black Religious Sounds in America: Origins of Gospel Music*, with L.D. Frazier; and *The Akan Tradition*, a look at a West African kingdom and religion and its heri-

Share the Thrills of Exploring Outer Space!

$359.95 f.o.b. Hartford, Conn.

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

Criterion Manufacturing Co.
620 Oakwood Ave., W. Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION, MANUFACTURING CO., Dept. NH120
620 Oakwood Avenue, W. Hartford, Conn. 06110
Please send your free Telescope Guide.

Name__________

Address__________

City__________ State__________

On safari with TRAVCOA you'll observe the mountain gorilla, the great migrations of the Serengeti Plain, and the rarely encountered wildlife of Virunga. Historical kingdoms, village markets and African custom unfold as we visit

AFRICA SAFARI

TOMBOUCTOU, GORILLA TREK, CAMEROONS AND TRIBAL LIFE

Tombouctou and the Cameroons. Or visit Tanzania's Ngorongoro Crater and the tree lions at Lake Manyara.

The vast landscape of South Africa is revealed to those who board the famous Blue Train and travel from Pretoria to Cape Town.

Membership for each program is limited to 25. A la carte dining and all-inclusive luxury facilities provide comfort in this remote and primitive land.

Travcoa
Dept. NH11 4000 MacArthur Blvd.
Suite 650E Newport Beach, California 92660

For future travel planning, please forward your 36-page Brochure.

Name__________

Address__________

City__________ State__________ Zip__________

Travel Agent__________

Also, please include the following TRAVCOA Brochures:

☐ Africa ☐ South Pacific ☐ Orient ☐ Unusual Orient ☐ Europe ☐ China ☐ Around the World ☐ Middle East ☐ India and Frontiers ☐ Mongolia ☐ Egypt ☐ South America (Including Glacier Cruise)

The power, the grace, and the beauty that place them among the world's most fascinating creatures fill *Guy Coheleach*'s paintings of THE BIG CATS. This lavish new volume, introduced by Roger Caras and priced at $65.00, includes scores of illustrations and color plates, printed with the consummate skill that marks

AN ABRAMS BOOK
110 East 59th Street, New York, N.Y. 10022

meteorite not moved from the Hayden Planetarium to the newly built Arthur Ross Hall of Meteorites in 1980. The new hall was simply not large enough for both it and the Ahnighito, the largest recovered meteorite in the world. Visitors can see (and children can climb into) the deeply pitted Willamette Meteorite on the first floor of the Planetarium.

Douglas J. Preston

tage in America, with Amadoma Bediako. This series is made possible in part by a grant from the William R. Hearst Foundation.

Native Americans on Video

The Education Department, in conjunction with the Museum of the American Indian, will present videotapes on the life of Native Americans at the Museum's Linder Theater as part of *Festival '82: Native Americans on Film and Video.* The tapes cover a broad range of topics and tribal groups. More than twenty will be presented in four programs: *Spiritual Expressions*; *The Circle of Life*; *Contemporary Issues*; and *Legacy for the Future: Traditional Art and Custom.* The videotapes will be shown continuously beginning at 10:30 A.M. on November 20 and 21 and are free to visitors. A full schedule for *Festival '82* (November 3–21) can be obtained by writing to: Film Program, Museum of the American Indian, Broadway at 155th Street, New York, N.Y. 10032.

Early Man in Africa

Archeologist David Price Williams will present a lecture, *Early Man in Africa: The Archeology of Swaziland*, at the Museum on Wednesday, November 24, at 7:00 P.M. in the Auditorium. For the past six years, Swaziland, an archeological microcosm of sub-Saharan Africa, has been the focus of excavations by an international team of archeologists. Williams will discuss their findings, which cover more than a million years of human habitation of this region. Evidence has now emerged that links seven phases of prehistoric evolution with major changes in past climate. There is no charge for this program, which is presented by the Education Department in cooperation with Earthwatch.

Origami Extravaganza

The annual Origami Holiday Tree will be unveiled to the public on November 22 in the Roosevelt Rotunda. This year's tree is more remarkable than ever, with thousands of animals made from folded paper, including bats, beetles, foxes, spiders, swans, dogs, hedgehogs, giraffes, and even cockroaches. Also on display are origami "habitat groups" showing scenes in which everything, from trees to rocks, is made out of folded paper.

Gifts from Mystic Seaport

A baby herring gull is guarded by its watchful parent — both are crafted in stoneware, hand painted in authentic colors. Together or separately they make a wonderful gift for lovers of the sea and shoreline.

Baby gull (2½" high): $16.50. Parent gull (8" long): $35.00. Parent and baby: $49.50. Please add $1.50 postage and handling. Satisfaction guaranteed.

MC/VISA/AmEx orders, include card no. and exp. date. Conn. residents add 7½% sales tax

Mystic Seaport's Catalog of Fine Gifts for the Yachtsman is a treasury of handmade crafts, ship models, nautical clothing and decorating ideas — many items exclusively ours. Send $1 for America's only full color catalog of nautical gifts from the shops of America's leading maritime museum. (Free with order.)

MYSTIC SEAPORT MUSEUM STORES
Dept. 956,
Mystic, CT
06355

Credit card phone orders: (203) 536-9957

ODOR-FREE LITTER BOX

Powerful charcoal air filter removes all odor!

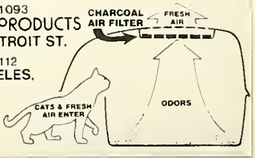
Litter odors are absorbed 100% by the special Boodabox® air filter scientifically treated with high grade odor absorbing activated charcoal.

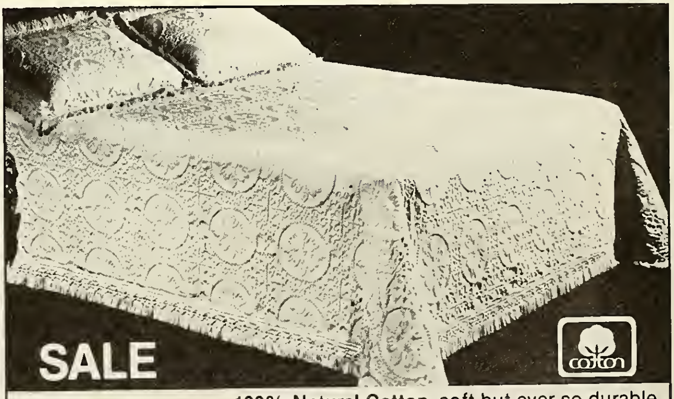
BOODABOX®
Guaranteed 100% odor-free

UNCONDITIONAL 30 DAY MONEY BACK GUARANTEE

■ Appeals to cats' privacy instincts ■ No training needed ■ Ends litter scatter ■ Conceals litter ■ Uses less litter ■ Lift top to clean covered pan ■ Fits any decor ■ Rugged Almond Beige ABS plastic ■ Deluxe textured finish ■ Sprayproof seal ■ Roomy 27"L x 16"W x 17"H ■ Big 8" x 14" entry ■ Filters last 6 months, $2.95 ea. (about 2¢ a day) ■ Filter reorder forms included ■ Liners available

$34.95 + $4.00 Shipping. Check or M. O.
Add $2.27 tax in Calif.
MC/VISA Call EXT 5
(213) 934-1093
BOODA PRODUCTS
439 S. DETROIT ST.
DEPT. NH-112
LOS ANGELES,
CALIF.
90036
© 1981
Pat Pend.





Beautiful Early American "COLONIAL LOFT" BEDSPREADS

- Heavy—soft—durable
- 100% Quality Cotton
- Machine washable
- Choose white or natural
- Special Prices:

Twin 80 × 110, value $40...... only $32.95
Full 96 × 110, value $50....... only $39.95
Queen 102 × 120, value $65. only $47.95
King 120 × 120, value $75.... only $55.95
Sham (standard), value $15... only $11.95 ea
Add $2.50 per order for shipping
N.C. Residents add 4% Tax

100% Natural Cotton, soft but ever so durable. A true legacy of Early America. This elegant woven bedspread is fully pre-shrunk and machine washable, with no ironing ever. Rich, full, all-cotton decorator fringe. **Guaranteed.** We ship fast.

Homespun Crafts • Dept. NH-6, Box 1776
Blacksburg, S.C. 29702

Gentlemen: Please rush ______________ "Colonial Loft"
______ Size spreads & ______ shams, color ______________
☐ Check ☐ M.O. enclosed ☐ M.C. ☐ Visa ☐ AMEX
Credit Card No. ______________ Exp. Dt. ________
Name ______________
Address ______________
City ______________ State ______ Zip ______

M/C, VISA orders—call toll free 24 hours.: 800-438-7939, Ext. NH-6 or dial 800-458-3491, Ext. 81-B. CALL NOW!

Additional Reading

Acid Rain (p. 8)

Last year German biochemist Bernhard Ulrich wrote an article in *Der Spiegel* in which he announced that West Germany's forests were being killed by sulfur dioxide from the industrial Ruhr Valley. A recent article by F. Pearce ("The Menace of Acid Rain," *New Scientist*, August 12, 1982, pp. 419–24) explains Ulrich's theories on the effects of acid deposition on soils and forests. It also provides up-to-date and concise information on how acid rain has poisoned lakes throughout Scandinavia; which countries are the polluters and which are the polluted; the prevalence of acid rain in Britain and the need for research to be conducted there; the interchange of acid rain between the United States and Canada; and possible ways to cut back on sulfur emissions from power stations and industrial boilers. I. Peterson gives a readily understandable explanation of how acid rain is formed in "To Catch a Cloud," (*Science News*, August 28, 1982, pp. 138–40). Research has revealed that chemical reactions within clouds and inside cloud droplets may contribute significantly to acid rain formation. Two other well-written and interesting articles for general reading are "Acid Rain—How Great a Menace?" by A. LaBastille and T. Spiegel (*National Geographic*, November 1981, pp. 652–80) and "An American Tragedy," by R.H. Boyle (*Sports Illustrated*, September 21, 1981, pp. 68–82). *Natural History*'s last article on the subject was G. Hendrey's "Acid Rain and Gray Snow," which appeared in the February 1981 issue (pp. 58–64); see that issue's "Additional Reading" section (pp. 100–01) for many more references.

Red Deer (p. 42)

T. Clutton-Brock and his coworkers F. Guinness and S. Albon recently collaborated on *Red Deer: The Behavior and Ecology of Two Sexes* (Chicago: Chicago University Press, 1982), a monograph about their work with the deer of Rhum. The authors compare and contrast the factors affecting breeding success in males and females, arguing that these differences are responsible for the evolution of pronounced sex distinctions in morphology, physiology, and behavior; these, in turn, have a wide variety of ecological consequences, including sex differences in feeding behavior, dispersion, and reactions to high population density. A more general reference appropriate for this article is *Sex, Evolution and Behavior*, by M. Daly and M. Wilson (North Scituate, Mass.: Duxbury Press, 1978).

Blanket Bogs (p. 48)

Mountains and Moorlands, by W.H. Pearsall (London: Collins, 1950), is an excellent, well-illustrated account of the natural history of the upland moors and bogs of Britain. Chapters cover structure, climate, soils, mountain vegetation, lower grasslands, woodlands, moorlands and bogs, vegetation and habitat, ecological history, upland animals, animal communities and birds, and conservation and utilization. W. Pennington's *The History of British Vegetation* (London: Hodder and Stoughton, 1974) is a readable introduction to the study of the development of Britain's vegetation. *Plants and Archaeol-*

"mmmm"

KAHLÚA Black Russian

The true classic:
an ounce of Kahlúa to two ounces of vodka on the rocks.

KAHLÚA White Russian

For a delicious change of taste, just add cream or milk.
And do send for the Kahlúa recipe book. Our compliments.
Maidstone Wine & Spirits Inc., P.O. Box 3925, Universal City, CA 91608.

© 1984 Kahlúa Imported Liqueur 53 Proof.

ogy, by G. Dimbleby (London: Granada, 1978), shows that plant remains in archeological sites are not as infrequent as we might think and discusses the conditions that favor plant preservation. More than half of this book, which is written for the general reader, probes how humans have made use of plants. The author discusses the ecological importance of plant cover and the consequences of its destruction; the incidence of various species in periods of time; the availability of wild plants as food through the seasons; the technological uses both in and outside of the homestead; ritual and medicinal uses; and the origins and spread of cultivated plants. Radiocarbon dating, tree ring analysis, and pollen analysis are also treated.

Swifts (p. 56)

Swifts in a Tower, by British ornithologist D. Lack (London: Chapman and Hall, 1973), intended for the general reader who wants to know more about the common swift of Europe, is well written and illustrated and avoids using technical terms. Based on ten years' observations of swifts nesting in a tower in Oxford, England, Lack's book provides an account of the life history of the common swift: courtship, feeding habits, flight, night behavior, migration, birth rate, and causes of death. In *Ecological Adaptations for Breeding in Birds* (London: Methuen and Co., 1968), Lack tries to determine the reasons for differences in breeding among birds, which he considers adaptations that evolved through natural selection. The book also "provides a review of nesting dispersion, the pair-bond, clutch size, egg size, the incubation and fledging periods and the age of first breeding in birds." *Parent Birds and Their Young*, by A.F. Skutch (Austin: University of Texas Press, 1976), is an up-to-date, worldwide survey of the family life and reproductive behavior of birds, from the formation of pairs to the juveniles' attainment of independence. This huge volume, with its more than one hundred illustrations and a bibliography of more than eight hundred titles, is a valuable reference work. During the early summers of 1962 and 1963, J.S. Rowley and R.T. Orr studied white-collared swifts in three nesting caves in Mexico. Their observations are compiled in "Nesting and Feeding Habits of the White-Collared Swift" (*Condor*, vol. 67, pp. 449–55), which reports on the swift's nest sites, eggs, food and parasites, and general behavior.

KAHLUA
IMPORTED
FROM SUNNY MEXICO
KAHLÚA
HECHO EN MEXICO
LICOR DE CAFÉ
COFFEE LIQUEUR
PRODUCT OF MEXICO
CARAMEL COLOR ADDED
HECHO POR
KAHLUA, S. A
FABRICA DE LICOR DE CAFE
WINE IMPORTERS, LOS ANGELES, CALIFORNIA

To Market, to Market . . . to Buy a Tortilla

Food counters in Los Angeles's Grand Central Market offer the most authentic Mexican food north of the border

by Raymond Sokolov

We return now to the scene of last month's unfinished expedition to the gastronomic wilds of downtown Los Angeles: to the Grand Central Market, a cornucopia overspilling with Chicano delicacies, ranging from esoteric Mexican sour creams to fresh cactus paddles to the whole gamut of chilies, from *cascabel* to *pasilla*. This is obviously a great place to shop if you want to prepare the classics of Mexican cuisine. But if you are only passing through Los Angeles, as I was, and have no time or kitchen for serious cooking, you can still get a tantalizing taste of what might have been by lining up at one of the Mexican food counters that operate in the market.

These are not fancy places, but they do turn out some of the most delicious and authentic Mexican food to be found north of the border. Off in a corner, not too far from the tropical-juice bar, is an extremely unassuming taco stand. For $1.20, you can buy two fresh tortillas rolled around a nondescript filling of chopped meat and lettuce. There is a mildly hot red sauce with chunks of tomatoes still visible in it, guaranteeing that it was made on the spot. And you can also munch the little yellow fresh chilies that sit on the counter as a sort of condiment. Nothing could be simpler. What makes it work are the tortillas. They are fresh and pliable, and they taste strongly, you might even say aggressively, of corn.

This is not the sugary flavor of fresh corn on the cob, but the musty, vaguely sour taste of hominy, which is dry corn from which the hull and germ have been

GC
GRAND CENTRAL
PUBLIC MARKET

Bill Ross, West Light

An Outstanding Opportunity for Collectors of Western Art

THE FIFTH IN A SERIES OF MUSEUM QUALITY BRONZE REPLICAS

"THE MOUNTAIN MAN" HAS BEEN SELECTED AS THE OFFICIAL COMMEMORATIVE BRONZE FOR THE INAUGURATION OF THE 40TH PRESIDENT OF THE UNITED STATES, RONALD REAGAN.

The original American "rugged individualist," the mountain man was immortalized by Frederic Remington in this striking bronze, which Remington completed in 1903.

More than any Western character, the mountain man typified the courage and daring of the first Western explorers.

A SOLITARY FIGURE IN AN UNCHARTED WILDERNESS

Alone for months at a time, the mountain men were the first Americans to explore the forest trails, the mountain passes, the rivers and lakes of the vast expanse of unsettled land, long before the coming of the '49ers, the cowboys, and the early railroads.

REMINGTON'S REALISM AT ITS BEST

The Mountain Man is one of Remington's most detailed bronzes. Every item of the mountain man's equipment is accurately depicted — his rifle, his traps, his blanket roll, knife, his fur hat and buckskins.

UNSURPASSED QUALITY IS GUARANTEED

The Mountain Man, in a strictly limited edition of 1,000, is cast by the lost wax process. Each bronze is foundry marked, numbered and dated. Modeled from 13 of the approximately 80 original casts Remington produced, the replica has been approved by the Director of The Buffalo Bill Historical Center. Each bronze is accompanied by a Certificate of Ownership signed by the Director, and your purchase is registered in your name in the Center's archives.

A REMARKABLE VALUE IN TODAY'S INFLATED ART MARKET

At a time when bronzes of lesser size and quality are priced from $3,000 up, this edition is offered to collectors at $1,875. We urge you to reserve your bronze now — there is a waiting list for the first three limited edition Remington bronzes that have been issued, and it is anticipated that the demand for this fine replica will also exceed the number of bronzes available.

GUARANTEED REPURCHASE AGREEMENT

Museum Collections Inc., unconditionally guarantees to repurchase your bronze at the issue price of $1,875 any time within one year of your purchase.

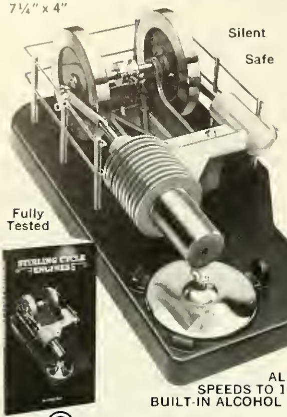
TO ORDER, CALL TOLL FREE . . .

800-243-4492, or write: Elizabeth Krieger, Director, Museum Collections Inc., Dept. H 51, 140 Greenwich Ave., Greenwich, Ct. 06830 for brochure. You may pay by check, money order or major credit card. Optional five month payment plan available.

Frederic Remington's "The Mountain Man"

Issued in cooperation with The Buffalo Bill Historical Center, Cody, Wyoming, in an edition of 1000, the replica is hand finished, foundry marked, numbered and dated. It is approximately 22 inches high with American Walnut base, three-fourths the size of the Remington original.

museum collections



The Amazing Stirling Cycle **Hot Air Engine**
7¼" x 4"
Heat is the only fuel required!

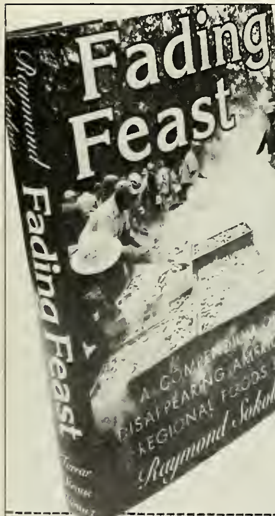
This miniature Stirling Cycle Engine measures 7" x 4¼" and comes complete with built-in alcohol burner. Red flywheels and chassis mounted on a green base, these all-metal beauties silently running at speeds in excess of 1,000 RPM attract attention and create awe wherever displayed. The model comes completely assembled and ready to run, accompanied by our "Stirling Cycle Engines" book. This is one of a series of four model hot air engines now available.

Experimenters • Hobbyists' Power Source
Students • Collectors • Model Engineers

An easily read, lavishly illustrated, 128-page book accompanies each engine or may be purchased separately. This publication, the first of its kind, takes the reader on a 160-year tour through the world of Stirling Cycle Engines.

ALL METAL
SPEEDS TO 1000 RPM
BUILT-IN ALCOHOL BURNER

Solar Engines • 4020 E. McDOWELL RD., PHOENIX, AZ 85008 U.S.A. (602) 273-6191
NH-11 *Please send me* ______ Engine and Book @ $53.50 . . . $______
______ Book (separately) @ $ 5.50 . . . $______
Enclosed
☐ Check ☐ Money Order
Charge My
☐ American Express ☐ VISA
☐ Master Charge
Domestic Shipments Price of Engine includes shipping via United Parcel Post Price of Book includes shipping via United States Mail Book Rate There will be an additional charge for ALL 1st Class or Air Mail Shipments
TOTAL $______
SIGNATURE
INTERBANK NO.
NAME (PLEASE PRINT)
CARD NO.
ADDRESS
EXPIRATION DATE
CITY STATE ZIP
CREDIT CARD BUYERS DIAL: (800) 528-6048


Fading Feast
Raymond Sokolov
A Compendium of Disappearing American Regional Foods by Raymond Sokolov
Farrar Straus Giroux

FADING FEAST

A Compendium of Disappearing American Regional Foods

by Raymond Sokolov

"If you care about American cooking, as I do, you will find *Fading Feast* an enormously rewarding book."
—Craig Claiborne

The culinary wisdom of our American past in over 100 recipes and their stories.

Special Offer:
Members of the American Museum of Natural History may purchase *Fading Feast* at a generous 20% discount off the retail price.

☐ Yes, I would like to order ______ copies of *Fading Feast* at $17.95—20%, or $14.36 each. Please add $1.50 shipping and handling per order. ☐ Check enclosed ☐ Please bill my credit card account
Credit card (circle one): MASTERCARD VISA
Acct No: ______
Expiration date: ______
Signature: ______
Name
Address
City
State Zip
Mail to: *Fading Feast, Natural History,*
Central Park West at 79th Street, New York, NY 10024

20% discount is in lieu of 10% members' discount.

leached with wood ash or quicklime. This prehistoric process was common to the agricultural Indian peoples of the Americas. They knew that the lye present in wood ash would separate the hulls from the nutritionally useful interior of the corn kernel. When ground, the resultant cornmeal, or *masa harina* in Spanish, was compact and stored well. Furthermore, it had a complex taste.

This taste pervades the cuisine that descended to modern Mexico from the Aztecs. It is a flavor impressed on the taste memories of millions of people whose basic bread is the flat, circular *masa* pancake called tortilla. Non-Hispanic Americans also eat tortillas by the million in pseudo-Mexican restaurants. But these mass-produced tortillas have only a formal resemblance to the genuine article, pressed out by hand and cooked slowly on a griddle over a wood or charcoal fire in the traditional manner.

When I visited Mexico City some years ago, I passed several peasant women who had set up tortilla "kitchens" on downtown street corners, where they slapped out their wares and sold them to commuters and others passing by at dusk. Their portable fires were beacons of an ancient, preindustrial culture subsisting in a dynamic modern metropolis.

Some of the feeling of this mix of new and old permeates the taco counters at the Grand Central market in L.A. The heaviest dose is available at Ana Maria's, a centrally positioned counter restaurant.

A girl in a pink dress reaches into a white plastic tub and pulls out some tortilla dough. With the precision of gesture the French call a *tour de main* (we might say "knack"), she pats the dough into thick disks, much thicker than regular tortillas. She plunks a set of them on a big griddle and cooks the batch slowly and carefully. These are called *gorditas*, "fat little cakes." When you order one, she splits it and fills it with various meats and vegetables.

Ana Maria's also runs a taco operation of serious refinement. The all-important tortillas are kept warm and moist in an electric warmer, and the customer selects the filling for his taco from a bracingly chilified selection that includes blood sausage, brains, the roasted bits of pork called *carnitas*, and the stew of mixed meats called *birria*. This apparently mundane carry-out restaurant is careful about the origins of what it serves. The *carnitas* are denominated *estilo Tepatitlán*, in the style of Tepatitlán; the *birria* is *birria estilo Jalisco.*

My background in these matters is too limited to permit me to clarify what these epithets specifically imply, and I certainly cannot say whether Ana Maria's brings off an entirely authentic version of either dish. At least the intent is there, and to someone accustomed to the endlessly repetitive fare of stateside Mexican restaurants, to yawn-making combination platters overspilling with shredded iceberg lettuce and processed American cheese, the tang and ingenuity of the tacos in the Central market were an arresting and exhilarating change of pace.

Of course, even these delicacies are only humble representatives of the full magnificence of Mexican cookery with its 2,000 recipes and its utterly original approach to the edible biosphere. Ana Maria's prepares what it prepares with real flair, but its offerings are limited to what Mexicans call *antojitos*, "snacks," or "appetizers."

The only places I have ever managed to find most of the legendary wonders of Mexican cuisine are in private homes or in books. Flipping through any of Diana Kennedy's cookbooks, with their invaluable divagations into informal ethnography, one craves a taste of, say, crepes filled with *huitlacoche* (mushroomlike corn fungus) or of chilies exploited with the ingenuity that Mexicans have developed over the last few centuries. But is there a Mexican restaurant, even in Mexico, that does more than scrape the surface of this repertoire? So much of dining out in Mexican restaurants, both here and in Mexico itself, leads in a tautologous circle that excludes virtually everything of interest in one of the world's most highly developed cuisines.

This is a problem not confined to Mexico and Mexican restaurants around the world. American regional specialties, with a few safe exceptions, do not appear on restaurant tables in most of the regions where they arose and where they are still eaten in people's homes. One hears the same cry of frustration over and over again from people who know the food of gastronomically fascinating places, such as Morocco or India. The local cuisine flourishes but you have to know someone who will invite you home. Even England does not display its hereditary riches of the table too frequently outside of a few eccentric "British" restaurants, which soldier on with insular brilliance, turning out bloody grouse and game chips and silverside and summer pudding. Oh, to be in England if they'd only stop "doing the continental." For me, it's jellied eel on Margate Pier anytime, rather than quiche in Soho.

International cuisine triumphs where skilled local cooks have lost their nerve

Which of these languages would you like to speak?

Mark the one you want to speak in 2 or 3 months' time

American English ☐
Arabic ☐
Chinese ☐
Danish ☐
Dutch ☐
French ☐
German ☐
Greek (Modern) ☐
Hebrew (Modern) ☐
Irish ☐
Italian ☐
Japanese ☐
Norwegian ☐
Polish ☐
Portuguese ☐
Russian ☐
Spanish ☐
Swedish ☐

A Linguaphone Course makes you feel at home in almost any country. You'll never miss the meaning of conversations or be at a loss for words.

- It must work—over 4 million Linguaphone students in 88 countries speak a second language FLUENTLY
- Proven learning success. You LISTEN to real conversations on cassettes. UNDERSTAND what you hear by following illustrated textbooks. HOLD CONVERSATIONS with the speakers
- **You start speaking the very first lesson.** You learn at your own convenience.
- It's like having a private tutor
- You get a complete, professional language program at little cost.
- You gain a good, working vocabulary.
- In just 2 to 3 months you can speak another language with complete confidence
- You develop an authentic accent. Only native-born speakers are used

Linguaphone The Language Masters

MONEY BACK GUARANTEE—28 DAY FREE TRIAL

World Language Courses, Inc. Dept 2D3 313 Nolana Ave. McAllen, Texas 78501

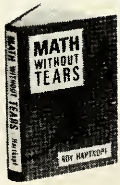
FREE INFORMATION: Please mail me FREE information about learning the languages I have checked. FREE brochure and demonstration cassette.

Name (please print) ____________________

Street ____________________

City __________ **State** ______ **Zip** ______

MATH WITHOUT TEARS



Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written.
Learn math in the comfort of your own home at minimum cost.

Order Now: $11.95 plus $1.25 hdlg.
EMERSON BOOKS, INC.
Dept. 666-G, Verplanck, NY
10596
10 Day Money Back Guarantee

EXPLORE DARWIN'S
GALAPAGOS

THE BUCCANEER
"Largest Galapagos ship"
Cruises from $477 Plus Air Fare
All outside Air conditioned Staterooms. Private baths. Includes all meals aboard. Shore excursions conducted by multi-lingual naturalist guides.
Also visit **MACHU PICCHU,**
THE AMAZON, QUITO, LIMA, CUZCO,
IQUITOS on new low air fare
Write for brochures, deck plans, tariffs, itinerary

GALAPAGOS, Inc.
Suite 112-C, 7800 Red Road, So. Miami FL 33143
Name ____________________
Address ____________________
City/State/Zip ____________________

TRAVCOA'S South Pacific includes a cruise of the Sepik region in New Guinea and the Trobriand Islands, where the colorful customs of the Stone Age survive today.

SOUTH PACIFIC

NEW GUINEA SEPIK RIVER CRUISE, SOLOMONS AND GREAT BARRIER REEF

Tour Tahiti's Bora Bora, Savaii, or travel Australia's native outlands from Sidney to Perth aboard the Trans Australian Railway.

In New Zealand, TRAVCOA tours the North and South Islands, including Milford Sound and Mt. Cook.

All of TRAVCOA's itineraries are limited to 25 members, include a la carte dining and all-inclusive luxury facilities.

Travcoa
Dept. NH11 4000 MacArthur Blvd.
Suite 650E Newport Beach, California 92660

For future travel planning, please forward your 36-page South Pacific Brochure.

Name ____________________
Address ____________________
City ________ State ______ Zip ______
Travel Agent ____________________

Also, please include the following TRAVCOA Brochures:
☐ South Pacific ☐ Orient ☐ Unusual Orient
☐ China ☐ Africa ☐ Europe ☐ Around the World
☐ Middle East ☐ India and Frontiers ☐ Mongolia
☐ Egypt ☐ South America (Including Glacier Cruise)

and quit doing what they do well in exchange for new menus they don't really, viscerally, understand. I remember an evening in Nashville some years ago when a local television talk show host shepherded me through the city's splashiest restaurants at breakneck pace so that I could review them on the air the next morning. We sampled sodden, ersatz Italo-Tennesseean pasta and tasteless barbecued ribs in a glass-and-veneer saloon of recent vintage. The nadir of this odyssey came in Nashville's most rarefied French restaurant, which featured a bearnaise sauce clotted with scrambled eggs.

Countries where local cuisine survives abundantly in restaurants are countries that combine xenophobia with a culture in which dining out is traditional. France and China are the preeminent examples of the happy conjunction of these two national traits. People in Morocco and Mexico, on the other hand, have preserved the knowledge of their great, traditional cuisines, but they have no important tradition of restaurant dining.

In this country, we have made a civilization by adapting foreign and local traditions to each other. Generally speaking, this "melting pot" process has pushed truly exotic immigrants into postures of partial assimilation. Operators of Greek luncheonettes will prepare a basically Anglo-Saxon, middlewestern cuisine of BLTs and doughnuts, Hellenized by a semi-Greek feta-cheese-topped salad. Chinese immigrants invented a pseudo-Chinese cuisine of chop suey and other Americanized specialties. Mexicans have imported a few basic dishes and toned them down for the American palate. Using American ingredients, assembly line tortillas, and bottled sauces, the typical restaurant can offer a reasonable facsimile of real Mexican street food.

In major cities, on the other hand, sophisticated specialty shops and the occasional serious restaurant battle to create ethnic authenticity for the cook or the diner. This trend usually operates at the high end of the economic scale, making the traditional food of peasant cultures available to the gastronomically alert elite of polished urban centers. At Ana Maria's, however, you can just walk up to the counter in shirtsleeves and taste a real *gordita* without paying for exposed brick and hanging asparagus ferns or suffering the idiotic temerity of an overbearing out-of-work actor playing the role of maître d'.

Raymond Sokolov's new book, Fading Feast *(Farrar, Straus and Giroux), is a collection of food columns that first appeared in* Natural History.

Ana Maria
LONCHERIA
MEXICAN FOOD TO GO
ROAST to GO
BEEF
LAMB
PORK
CHICKEN
TACOS
GORDITAS

Bill Ross, West Light

Recipes adapted from *The South American Cook Book*, by Cora, Rose, and Bob Brown (Dover Publications)

Tortilla Dough

3 cups whole corn kernels
1½ cups wood ash or ½ cup quicklime
½ cup lard
½ yeast cake or 1 package dry yeast
Salt
Pepper

1. Boil corn with wood ash or quicklime and enough water to float the corn, until the corn is tender. Rinse four times.
2. Rub off and discard hulls, and mash the remaining hominy.
3. Mix in the lard, reserving 1 tablespoon.
4. Dissolve the yeast in a little warm water. Add to the dough along with salt and pepper.
5. Mix the ingredients together and knead until smooth. Let stand in a warm room, covered with a damp cloth, for 2 hours.
6. Knead again, adding the remaining tablespoon of lard. At this point, the dough is ready to be patted into tortillas or *gorditas*.

Gorditas

Pat out tortilla dough in ½-inch-thick circles. Cook slowly on a dry griddle, turning frequently. *Gorditas* take a while to cook through. Split the finished *gorditas* and fill with refried beans or almost any filling suitable for a sandwich.

UPWARD SNOWBILITY.

'83 Ford Bronco takes to the mountains with more torque than any 6-cylinder 4-wheeler. It's just one reason Bronco is the No. 1 seller in its class.† Inside, there's room and comfort for six with optional twin bench seats. Or go with standard bucket seats up front. Even underneath, Bronco's up on the competition. It's the only full-size, American-built sport utility with independent front suspension. Tough Ford Bronco. It's a beautiful way to go!

Get it together — Buckle up.

Optional Captain's Chairs shown

27 EST HWY 18 EPA EST MPG 4.9L Six and optional overdrive. Use for comparison. Your mileage may differ depending on speed, distance and weather. Actual highway mileage lower. California ratings may be less. See your Ford Dealer for the 1983 EPA Gas Mileage Guide.

FORD BRONCO

FORD DIVISION Ford

AMERICA'S TRUCK

TOUGH FORD BRONCO

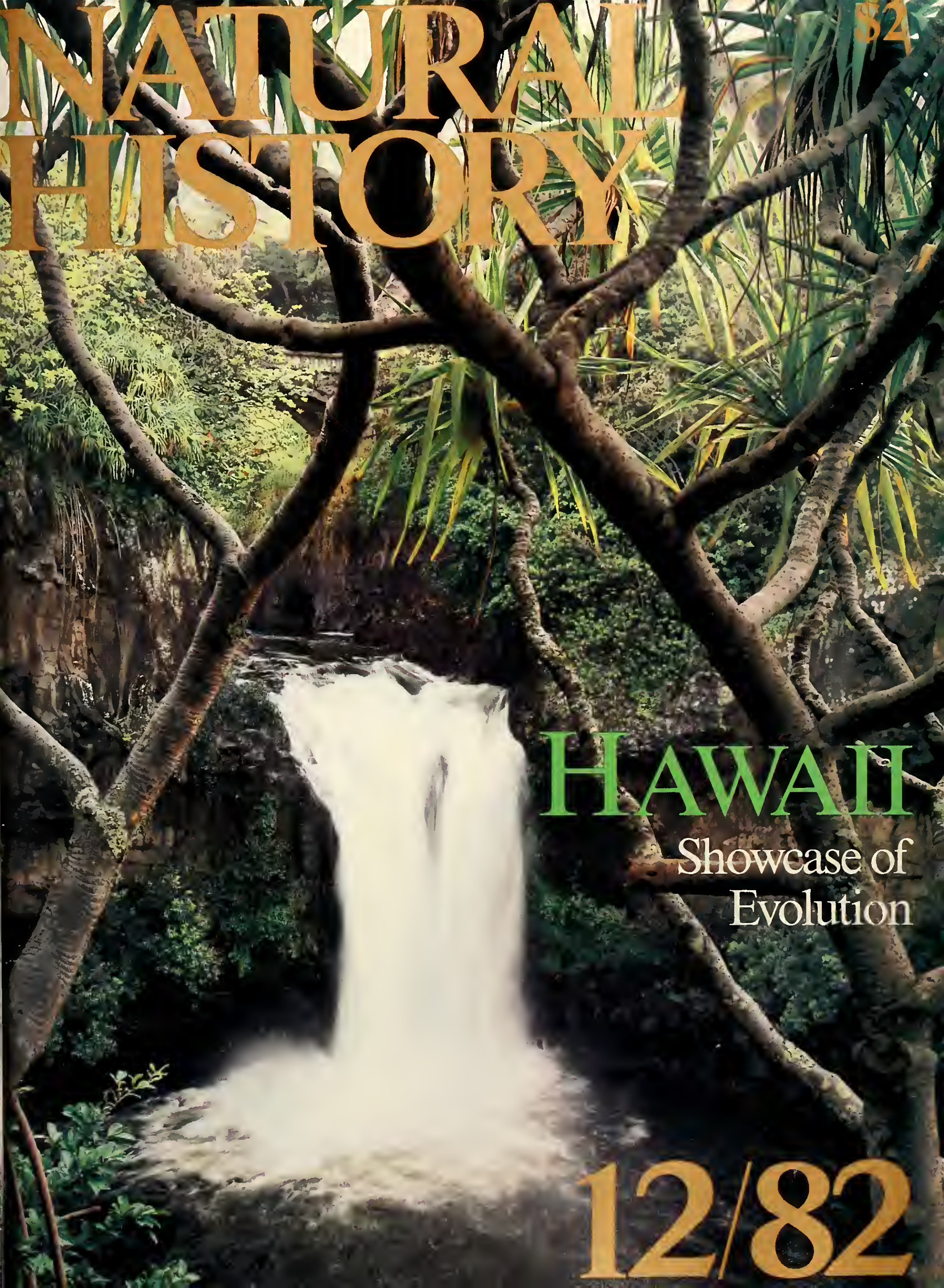
---

†Based on R.L. Polk & Co. calendar year registrations as of May, 1982.

"I padded across the rooftops wearing the night like a magician's black cape. And there they were. Sharing the moment, sharing each other, sharing Dubonnet. The Dubonnet Rouge, they took on the rocks with a twist and a splash. The Dubonnet Blanc, as a spritzer with soda. Dubonnet. Lighter than a cocktail, more interesting than wine. At least something is going right tonight."

Dubonnet
Dubonnet
Dubonnet®
Share the moment.

Dubonnet Aperitif Wine • Product of U.S.A. • © 1982 Schenley Imports Co., N.Y., N.Y.



NATURAL HISTORY

$2

HAWAII

Showcase of
Evolution

12/82

Dinner for 12 by Aynsley.® $21,392*

(not including the food)

Even in the palaces of kings, this is the dinner service usually reserved for occasions of state. 22 karat gold & blue Cobalt, mined in Africa, transformed in England.

Here, art gives birth to rare beauty. It is an art one must regard with awe. To acid-etch an intricate design into the glazed surface of each piece demands skill of the highest order; to coat it once, then again, with burnished 22 karat coin gold—an even more unforgiving task. Each layer of gold is separately fired at 1436 degrees, hot enough to fuse it forever. The quintessential heirloom is born.

Are you ready for this extraordinary investment?

Georgian Cobalt by Aynsley. Easily, the epitome.

*Includes 176 pieces.

Georgian Cobalt, 5-pc. place setting, $455. Other acid-etched patterns: Empress Cobalt, $365. Gold Dowery, $245.
For store names, write to Aynsley English Bone China, 225 Fifth Avenue, New York 10010.

NATURAL HISTORY

Vol. 91, No. 12, December 1982

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director
David D. Ryus, Vice-President

2 **Authors**

8 **This View of Life** *Stephen Jay Gould*
Of Wasps and WASPs

HAWAII: Showcase of Evolution

During this season of cold wind, snow, and barren trees, Natural History *looks at that part of the United States that comes closest to being a tropical paradise. Hawaii's lush landscapes would have enticed a Gauguin; its life histories would have inspired Darwin. Its many fascinating aspects caused the magazine for the first time to devote practically a complete issue to one region. Chris Simon was consulting editor for this project.*

16 **An Introduction** *Hampton L. Carson*

20 **The First Arrivals** *Sherwin Carlquist*

32 **Transported Landscapes** *Patrick V. Kirch*

36 **Radiating Silverswords**

40 **Birds of the Forest** *C. John Ralph*

48 **A Seal Slips Away** *Robert J. Shallenberger*

54 **The Flies Fan Out** *Kenneth Y. Kaneshiro and Alan T. Ohta, photographs by Raymond A. Mendez*

60 **Life Crawls Upstream** *John I. Ford and Robert A. Kinzie III, photographs by Raymond A. Mendez*

68 **The Next Island** *William R. Normark, David A. Clague, and James G. Moore*

72 **A Cloudy Future** *Hampton L. Carson*

---

74 **Sky Reporter** *Stephen P. Maran*
Fall from Space

80 **Celestial Events** *Thomas D. Nicholson*

84 **At the American Museum**
Star Gods of the Ancient Americas

88 **Additional Reading**

91 **A Matter of Taste** *Raymond Sokolov*
A Garden of Earthy Delights

Cover: *A view of the waterfalls at Sacred Pool No. 3, in Haleakala National Park on the island of Maui, Hawaii. Ed Cooper Photo.*

Alan Ternes, Editor
Managing Editor: Erik Eckholm
(Judith Friedman, on leave)
Thomas Page, Designer
Board of Editors: Carol Breslin,
Sally Lindsay, Frederick Hartmann,
Vittorio Maestro, Rebecca B. Finnell
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
E. Kay Danzig, Art Asst.
Kay Zakariasen, Picture Editor
Kelly L. Matthews, Editorial Asst.
Lillian Berger

L. Thomas Kelly, Publisher
Bradford D. Smith, Business Manager
Ernestine Weindorf, Asst. to the Publisher
Carol A. Midkiff
Cary Castle, Circulation Manager
Jeff Pieper, Assoc. Circulation Mgr.
Ramón E. Alvarez, Asst. Circulation Mgr.
Frank Stevens, Asst. Fulfillment Mgr.
Frederick E. Grossman, Production Manager
Debra Buck McCord, Asst. Production Mgr.
Elaine M. Callender, Advtg. Production Mgr.
Douglas J. Preston, Publications Manager

Natural History *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Subscriptions: $15.00 a year. In Canada and all other countries: $20.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.*

Copyright © 1982 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.*

Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Director, Don Kamens

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225

Subscription orders, change of address notices, undeliverable copies, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

Authors

Struck by the wide range of life forms on Hawaii and strongly concerned over the threats to their existence, **Chris Simon** conceived the idea of doing a special issue on the islands. Now a research associate with the Bishop Museum in Honolulu, Simon moved to the islands after her marriage and has continued her work on periodic cicadas (see "Debut of the Seventeen-Year-Old Cicada," *Natural History*, May 1979). Simon has extended her research interests to include Hawaiian drosophilid flies and *Toxorhyncites* mosquitoes. She writes that Hawaii is the best place to study speciation and evolution because "95 to 99 percent of its terrestrial biota is endemic and recently evolved."

Numerous visits to Hawaii and other oceanic islands made botanist **Sherwin Carlquist** vividly aware of the vast spans of water that frequently separate those islands from potential sources of nonhuman colonization. His research activity over the past thirty years has been directed, in part, to an effort to understand how plants and animals disperse to islands. He is the author of several books; three pertain to islands—*Island Life: A Natural History of the Islands of the World* (1965); *Hawaii: A Natural History* (1970); and *Island Biology* (1974). Carlquist is Horton Professor of Botany at Pomona College and Claremont Graduate School, both in California.

Human modification of Pacific island ecosystems began to interest **Patrick V. Kirch** when he was a graduate student in anthropology at Yale University. Kirch received his Ph.D. in 1975, and has since investigated this subject in Hawaii, the Solomon Islands, western Polynesia, and Micronesia. Now an anthropologist at the Bishop Museum in Honolulu, Kirch has been head of the museum's Division of Archeology since 1981. He is currently the principal investigator in an NSF-supported project on the archeology and ethnohistory of the Anahulu Valley, Oahu, Hawaii.

Hampton L. Carson first became interested in Hawaiian *Drosophila* flies as the result of a conversation with the late Wilson Stone of the University of Texas. The year was 1962 and studies of these amazing flies were in their infancy. Now a professor of genetics at the University of Hawaii, Carson has many years of research on *Drosophila* under his belt. His field of study embraces the evolutionary genetics, cytogenetics, and behavioral and population genetics of *Drosophila*. He is the author of approximately 175 scientific articles and one book, *Heredity and Human Life.*

From 1976 to 1982, **C. John Ralph**, an ecologist with the U.S. Forest Service, led a team in Hawaii studying the effects of different land uses on wildlife communities, especially birds. Although he now lives in Arcata, California, where he is examining the effects of timber management strategies on northern California wildlife, Ralph is still sifting through the mountain of data compiled in Hawaii. He grew up among avid birders in Berkeley and reports, "I decided to get paid for my hobby by becoming an ornithologist." He holds a doctorate in behavioral ecology from the Johns Hopkins University.

SUBSCRIPTION APPLICATION

The 100 Greatest Stamps Silver Miniature Collection

Must be postmarked by December 31, 1982
Limit: One collection per person

The Franklin Mint
Franklin Center, Pennsylvania 19091

Please enter my subscription for The 100 Greatest Stamps of the World collection, consisting of 100 finely detailed sterling silver miniatures, to be sent to me at the rate of two per month, at the guaranteed issue price of $4.75* per miniature. I will be billed for my silver miniatures prior to shipment. I will also receive a custom-designed presentation case, special magnifier and collector's tongs at no additional charge.

**Plus my state sales tax and 25¢ for shipping and handling.*

Signature______________________________
ALL SUBSCRIPTIONS ARE SUBJECT TO ACCEPTANCE

Mr. / Mrs. / Miss__________________________
PLEASE PRINT CLEARLY

Address_______________________________

City _________________________________

State, Zip_____________________________

THE FRANKLIN MINT IS THE WORLD'S LARGEST PRIVATE MINT. IT IS NOT AFFILIATED WITH THE U.S. MINT OR ANY OTHER GOVERNMENT AGENCY

© 1982 FM

A

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BD

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 1 FRANKLIN CENTER, PENNSYLVANIA

POSTAGE WILL BE PAID BY ADDRESSEE

THE FRANKLIN MINT
Franklin Center, Pennsylvania 19063

B

The world's greatest stamps silver miniatures

A complete collection of the 100 most significant stamps ever issued – each portrayed in remarkable micro-detail by The Franklin Mint.

And you can acquire these sterling silver miniature stamps –at just $4.75 each by entering your subscription now.

The 1869 United States 24¢ Inverted Center is one of the rarest of all American stamps. It bears the famous John Trumbull painting portraying the signing of the Declaration of Independence. But through a printing error, the image is shown upside down on the stamp. (Silver stamp shown at left actual size; at right, enlarged to show fine detail.)

Your eye is first attracted by the brilliance of silver. But as you look closer, the lines of an intricate design begin to take shape before you. Then, you place the sterling silver miniature under a magnifying glass—and there, in astonishing detail, is one of the world's greatest stamps!

This is the pleasure that awaits you with each new issue of The 100 Greatest Stamps of the World—as you discover the intriguing world of the minted miniature. A world that combines the beauty of solid sterling silver with the fascination of painstaking detail in the tiniest possible area.

This exciting new collection, to be produced by The Franklin Mint, will consist of 100 meticulously crafted miniatures—each one portraying one of the greatest stamps of history.

The rarest and most coveted of all stamps

A panel of distinguished authorities on world philatelic issues has selected, out of the many thousands of stamps issued throughout the world, the 100 greatest of all. And these are the stamps that will be *authentically re-created* for this exceptional —and very beautiful—collection.

Among them are: the British Guiana One-Cent Magenta, which brought the record price of $850,000 at an auction in 1980—the Penny Black of Great Britain, the first adhesive postage stamp in the world—the U.S. 24¢ Airmail Invert, one of the rarest of all American stamps—the Japan 500 mon Dragon, which was first thought to be a forgery but is now a prized rarity. And such famous issues as the Double Geneva, Moldavian Bull, Trinacria of Naples—100 great stamps in all, from every part of the world.

Superbly crafted works in miniature

Each sterling silver miniature will recapture the stamp it portrays with absolute authenticity. You'll actually be able to see every detail of the American biplane which is shown on the 24¢ Airmail Invert. Every feature of Queen Victoria's portrait on the Penny Black. The intricate background pattern that distinguishes the One-Cent Franklin "Z" Grill. The winged headdress on the "Hermes Head" stamp of Greece.

So that you will be able to study and enjoy each miniature in close-up detail, a special *magnifying glass* and *collector's tongs* will be provided. And you will receive a custom-designed *presentation case* to house and protect the complete collection of silver miniatures.

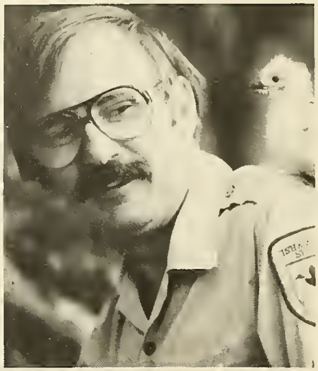
A limited edition at a guaranteed price

You will receive your silver miniatures at the convenient rate of two per month, and the issue price of just $4.75 will be *guaranteed* to you for each miniature in the collection—regardless of inflationary pressures.

The 100 Greatest Stamps Silver Miniature Collection will be permanently limited to the exact number of subscriptions entered by the end of 1982. After that, it will *never* be offered again.

No payment is required at this time. However you must mail the postpaid card to The Franklin Mint, Franklin Center, PA 19091, no later than December 31, 1982.

The manager of the Hawaiian and Pacific Islands National Wildlife Refuge Complex, **Robert J. Shallenberger** is responsible for twelve national wildlife refuges for the U.S. Fish and Wildlife Service. Research conducted under his direction includes the development of population-monitoring tools for resident sea birds and studies of their oceanic distributions. The endangered Hawaiian monk seal has been of special concern to him since 1971, and he is now investigating the factors limiting this marine mammal's population and distribution. In his free time, Shallenberger enjoys flying and rebuilding planes, wind surfing, and diving.

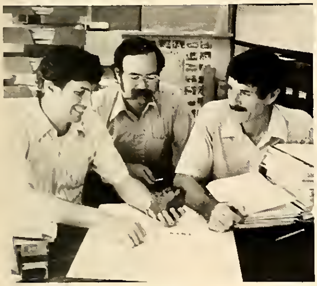


John I. Ford, right, is a fishery biologist with the U.S. Fish and Wildlife Service. He has been fascinated with the biota of Pacific island streams since 1974, when he began his research on the relatively low species diversity in Hawaiian streams compared to other western Pacific streams. He is now investigating the factors influencing the distribution of a rare goby in Hawaiian streams and the life history of an endemic Hawaiian freshwater snail. He writes that he enjoys fieldwork, despite the hazards of scaling waterfalls, swinging through vines, and rappelling slick, muddy slopes.

Coauthor **Robert A. Kinzie III**, left, is an associate professor in the Department of Zoology of the University of Hawaii. He spends about two-thirds of his research time on the ecology of coral reefs and one-third on tropical freshwater streams, and is especially interested in the interconnections between stream and marine fauna. Kinzie recently contracted a near fatal case of leptospirosis while working in a stream on Kauai. He is now recovered and plans to plunge back into his studies.

In his second year at the University of Hawaii (1963), **Kenneth Y. Kaneshiro**, right, was hired as a glassware washer for the Hawaiian Drosophila Project. Since then, he has earned a B.A., M.A., and Ph.D. while working as an undergraduate lab technician, graduate research assistant, and finally as the coordinator of the project. His main research involves the genetics of the Hawaiian Drosophilidae and the Mediterranean fruit fly. To better understand the factors affecting the population densities of these flies, Kaneshiro is analyzing their mate-recognition patterns. He is also codirector, with Hampton L. Carson, of the Hawaiian Drosophila Research Stock Center.

An assistant researcher in the Department of Entomology of the University of Hawaii, coauthor **Alan T. Ohta**, left, has been trying to determine the relative importance of environment and genetics in the regulation of ovipositional behavior in Hawaiian *Drosophila*. This behavior can alter the ecology of insect populations. He is also completing efficacy studies on the eggs and larvae of the Mediterranean fruit fly in California. He and his colleagues do their entomological fieldwork on islands other than Oahu, as very little of the native forest still exists there. Ohta's ambition is to mount a trip around the Pacific Basin to search for the probable progenitor of Hawaiian *Drosophila* flies.



All three authors of the article on Loihi, the underwater volcano, are affiliated with the U.S. Geological Survey at Menlo Park, California, and spend much of their working time either on or under the sea. **William R. Normark**, center, who has a Ph.D. in oceanography from Scripps Institution of Oceanography in La Jolla, California, has participated in thirty-four scientific cruises since 1965 and been chief scientist on fourteen of them. Among his current projects is one on the marine geology of ocean thermal-energy conversion sites off Hawaii.

David A. Clague, left, earned his doctorate in earth sciences, also from Scripps, and has been working for ten years on the origin and evolution of linear volcanic island chains, with particular consideration of the Hawaiian-Emperor chain. His commitment to the sea extends to his leisure time, which he often spends fishing, sailing, or skin diving.

James G. Moore, right, although born in California, came east to get a Ph.D. in geology from the Johns Hopkins University in Baltimore. He lived for several years on the island of Hawaii where he studied the eruptions of the Kilauea volcano. That research led to a "fascination with the 90 percent of the volcano hidden beneath the sea" and to a number of oceanographic cruises in which the processes of submarine volcanism were studied by echo sounder, dredging, and submersible. The results of a 1971–73 scuba diving investigation of underwater lava flows were documented in an educational film entitled *Fire Under the Sea: The Origin of Pillow Lava.*

CHIVAS BROS
PRODUCED IN SCOTLAND
IMPORTED
LOCHAN ORA
LIQUEUR
CHIVAS BROTHERS LTD.

The Chivas Regal of Liqueurs.

Chivas Brothers make the world's finest Scotch. And the same renowned Chivas quality and tradition goes into its equally-regal Lochan Ora Liqueur. With a unique taste all its own. Lochan Ora is to be lingered over—sipped slowly, savored fully. It's expensive but, then, good taste invariably is.

Lochan Ora.
The Imported Liqueur from Chivas Brothers.

70 PROOF • IMPORTED BY GENERAL WINE & SPIRITS CO., N.Y., N.Y.

The Information Age is calling.

Your simple, everyday telephone is about to become something much more. It's about to become your link with the future–the Information Age.

As the Information Age begins to change the way Americans live and work, some major changes are taking place in our industry. Changes in technology. Changes in how we're organized. Changes in the way you do business with us.

We think these changes are for the better. And we agreed to them because we're looking to the future. Ours and yours.

The only way we could move ahead was to change. Because of the many regulations and restraints the telecommunications industry in this country was forced to operate under, many technological advances were held in check.

The new telecommunications policy of this country, with the resulting changes at the Bell System, will remove most of those barriers to new uses of technology. Even now, this new technology is helping to usher in the Information Age.

At this very moment, some homeowners are using the telephone network to dial up news and weather maps on their home video screens. They can shop from department-store catalogs. And even compare supermarket specials.

With their ordinary home telephone lines providing transmission to a video screen, they can dial up information on seats on airlines or in local restaurants. They can even bank at home.

Soon, local utilities will be able to use telephone lines to take remote readings of your gas and electric meters. And you'll be able to use those same telephone lines to monitor and remotely control home energy usage.

The ability to expand technology and make telecommunications a more important part of your life than ever before is a direct result of the changes taking place at the Bell System.

Along with your local Bell Telephone company, we'll be telling you about these changes as they occur. In ads like this.

In each of these ads you'll find a telephone number. That number is an important part of our "Let's Talk" program. This program has been set up by the Bell System to help you understand exactly what the changes at the Bell System will mean to you right now. And in the future.

Call us. At 1 800 555-5000.

There'll be somebody to talk to. Somebody to help you. Somebody to answer your questions. To get you information.

So call us. And we'll be talking to you. **Let's talk.**

Bell System

Of Wasps and WASPs

"There ain't no sin and there ain't no virtue. There's just stuff people do"

by Stephen Jay Gould

"He is hurling the insult of the century against our mothers, wives, daughters and sisters, under the pretext of making a great contribution to scientific research." Thus did Louis B. Heller, congressman from New York, label the Kinsey report on *Sexual Behavior in the Human Female* (1953) in a letter to the postmaster-general, urging that the book be banned from the mails. Dr. Henry Van Dusen, president of the Union Theological Seminary, doubted Kinsey's facts but proclaimed that if true nonetheless, "they reveal a prevailing degradation in American morality approximating the worst decadence of the Roman empire." "The most disturbing thing," Van Dusen continued in castigating Kinsey's report, "is the absence of a spontaneous, ethical revulsion from the premises of the study."

Yet the premises seemed uncomplicated enough. Kinsey had sought, through extensive interviews with more than 5,000 women, to compile a statistical record of what people do do, rather than what law and custom say they should do. He passed no judgment and merely reported his findings; he did, however, discover a frequency of premarital and extramarital sexual relations that, to say the least, disturbed the chivalric code of many naïve, hypocritical, or smugly satisfied people—particularly older men in power.

Alfred C. Kinsey had the misfortune to publish his report in 1953 at the height of McCarthyite hysteria in America (his earlier 1948 report on the human male had caused a stir but had not inspired such calumny, perhaps because society has always accepted a wider range of behavior among males and because the immediately postwar political climate had been much more liberal). Many labeled it outright communist or, if not directly so, sufficiently weakening of American moral fiber to allow easy communist access to our troubled shores. A special House Committee, established to investigate the use of funds by tax-exempt foundations and led by noted cold-warrior B. Carroll Reece, dragged the Rockefeller Foundation onto its carpet. The foundation capitulated to these and other pressures, and Kinsey's main source of support ended abruptly in 1954. The Reece Committee issued its majority report in December 1954, accusing some foundations of using tax-exempt monies for studies "directly supporting subversion." The Kinsey reports were explicitly cited as unworthy of the aid they had received. Kinsey never did find an alternate source of support; he died two years later, overworked, angry, and distressed that so many years of further data might never see publication (renewed funding came later, but not in time for Kinsey's personal vindication).

Kinsey was no lifelong crusader for sexual enlightenment. He drifted into sex research almost by accident (though not without prior interest). He had been trained as an entomologist and was, at the time of his shift in careers, one of America's foremost taxonomists of wasps (six-legged, not two-legged). Soon after his switch, he began a Phi Beta Kappa lecture at Indiana University with these words:

> With individual variation as a biologic phenomenon I have been concerned during some twenty years of field exploration and laboratory research. In the intensive and extensive measurement of tens of thousands of small insects which you have probably never seen, and about which you certainly cannot care, I have made some attempt to secure the specific data and the quantity of data on which scientific scholarship must be based. During the past two years, as a result of a convergence of circumstances, I have found myself confronted with material on variation in certain types of human behavior.

Most people, when they learn of Kinsey's earlier career, tend to regard the discovery with quaint amusement. How odd that a man who later shook America should have spent most of his professional career on objects that most people have "never seen" and about which they "certainly cannot care." Surely there can be no relationship between two such disparate careers. As one wag wrote in a graffito on the title page to Harvard's only copy of Kinsey's greatest monograph on wasps: "Why don't you write about something more interesting, Al?"

I wish to argue, however, that Kinsey's wasps and WASPs were intimately related in his common intellectual approach to both. And since wasps preceded WASPs, Kinsey's career as a taxonomist had a direct and profound impact upon his sex research. In fact, Kinsey pursued his sex research by following a particular "taxonomic way of thought," a valid style of science that does not match most stereotypes of the enterprise. The special character of Kinsey's work—the aspects that brought him such fame and trouble—flowed directly from the taxonomic approach he had learned and perfected as an entomologist.

Aside from the specific conclusions that so shocked America—basically the high frequency of things that nice people supposedly didn't do, from homosexuality to premarital and extramarital sex among women to the high frequency of sexual contact with animals among men who had grown up on farms—Kinsey stirred the world with his different procedural approach to sex research. He worked with three basic premises, all flowing directly from his taxonomic perspective. First, he would base his conclusions upon samples far larger than any previous researcher had gathered. No more extrapolations to all of humanity from a small and homogeneous population of college students. Second, his sample would be heterogeneous—old and young, farm and city, poor and rich, illiterate and college educated. As wasps varied from tree to tree, classes, sexes, and generations might differ widely in their sexual behavior. Third, 1983 FORD *LTD* CROWN VICTORIA

IT'S A COMFORT TO KNOW YOU CAN STILL OWN THIS MUCH CAR.

Crown Victoria for 1983. Quiet. Smooth riding. Full size. With comfort and luxury for six passengers. Standard this year is a 5.0 liter fuel injected engine with automatic overdrive transmission. Rich velour fabrics, thick carpeting and warm woodtones create a quiet place for you to relax. While a solid steel frame and remarkable sound insulation make it clear you're riding in a truly fine automobile.

LTD Crown Victoria for 1983. In two- and four-door models. It's so rewarding to own one. Isn't it nice to know you still can?

Get it together—Buckle up.

HAVE YOU DRIVEN A FORD...LATELY?

Ford

FORD DIVISION

Better
Than
Jogging

NordicTrack

Jarless Total Body Cardiovascular Exerciser Duplicates X-C Skiing for the Best Motion in Fitness

The enjoyable sport of cross-country skiing is often cited by physiologists as the most perfect form of cardiovascular exercise for both men and women. Its smooth, fluid, total body motion uniformly exercises more muscles and higher heart rates seem easier to attain than when jogging or cycling. NordicTrack closely simulates the pleasant X-C skiing motion and provides the same cardiovascular endurance-building benefits—right in the convenience of your home. Makes a year round, consistent exercise program easily attainable. Eliminates the usual barriers of time, weather, chance of injury, etc. Also highly effective for weight control.

Better Than Running
NordicTrack gives you a more complete work out—conditions both upper body and lower body muscles at the same time. Fluid, jarless motion will not cause joint or back pains as jogging or running often does.

More Effective Than Exercise Bikes
NordicTrack's stand-up skiing motion more uniformly exercises large leg muscles and also adds important upper body exercise. Higher pulse rates, necessary for building fitness, seem easier to attain because the work is shared by more muscle mass. The NordicTrack also keeps more muscles in tone.

Even Better Than Swimming
NordicTrack more effectively exercises the largest muscles in the body, those located in the legs and buttocks. These muscles' main function is to lift and propel the body in the standing position. However, when swimming, the body is supported by the water, thus preventing these muscles from being effectively exercised. The stand up exercising position on the NordicTrack much more effectively exercises these muscles.

A Proven, High Quality Durable Product
Ruggedly constructed, NordicTrack is quiet, motorless and folds compactly for storage. Separately adjustable arm and leg resistances. NordicTrack is in its 6th year of production and is used in thousands of homes and many companies. We manufacture and sell direct. Two year warrantee, 15 day trial period with unconditional return privilege.

For more information write or call
TOLL FREE 1-800-328-5888
8 AM-5 PM MON.-FRI.
PSI 124 L Columbia ct. Chaska, MN 55318
Minnesota 612-448-6987

he would pass no judgments but merely describe what people did.

Kinsey received his Ph.D. in entomology from Harvard and then accepted a post as assistant professor of zoology at the University of Indiana, where he remained all his life. He spent the first twenty years of his career in a study, conducted with unprecedented detail, of the taxonomy, evolution, and biogeography of gall-forming wasps in the genus *Cynips*. These small wasps lay their eggs within the tissues of plants (usually the leaves or stems of oaks). When the larvae hatch, they induce the plant to form a gall about them, thus securing both protection and a source of food. The larvae mature within their galls, eventually emerging as winged insects to begin the process anew. Kinsey presented his work on *Cynips* in a number of shorter papers and two large monographs, *The Gall Wasp Genus* Cynips*: A Study in the Origin of Species* (1930, Indiana University Studies, vol. 16, 577 pp.) and *The Origin of Higher Categories in* Cynips (1936, Indiana University Publications, Science Series no. 4, 334 pp.).

In 1938, in response to student petition, the university established a noncredit course on marriage (a euphemism, I suppose, for some sex information). Kinsey, who had planned to spend the rest of his life studying wasps, was asked to serve as chairman of the committee to regulate this course and to give three lectures on the biology of sex. Kinsey was conscientious and empirically oriented to a fault. He went to the library to find the required information about human sexual response—and he couldn't. So he decided that he would have to compile it himself. He began by interviewing students but soon realized that he was not getting representative information about American heterogeneity. He began to travel on weekends, gathering information in nearby towns at his own expense. He developed an extensive format for interviews (at which he was an unquestioned master) and wrote the responses in code to assure anonymity. He recorded enormous variation in sexual behavior among people of different economic status, extending his researches to Gary, Chicago, Saint Louis, and to Indiana prisons. As his work became more public, criticism mounted, but the university remained firm in its support of Kinsey's right to know.

Eventually, with the university's backing, he established the Institute for Sex Research and secured Rockefeller Foundation money for his burgeoning interviews and their publications. His work culminated in two great volumes, *Sexual Behavior in the Human Male* and *Sexual Behavior in the Human Female*, each based on more than 5,000 interviews with white Americans of diversified backgrounds. (True to his belief in the fundamental character of variability, Kinsey knew that he did not have enough data to reach conclusions about black Americans or to extrapolate to other nations and cultures.) Long before these volumes appeared, Kinsey had, with great reluctance and sadness but with creeping inevitability, abandoned the wasp work that had brought him so much pleasure and had set his standards of scientific work.

Although Kinsey confined his major works on wasps to a single family, the Cynipidae, his aims were as broad as natural history itself. He thought deeply about the practice and meaning of classification and hoped to reformulate the principles of taxonomy. He wrote in 1927:

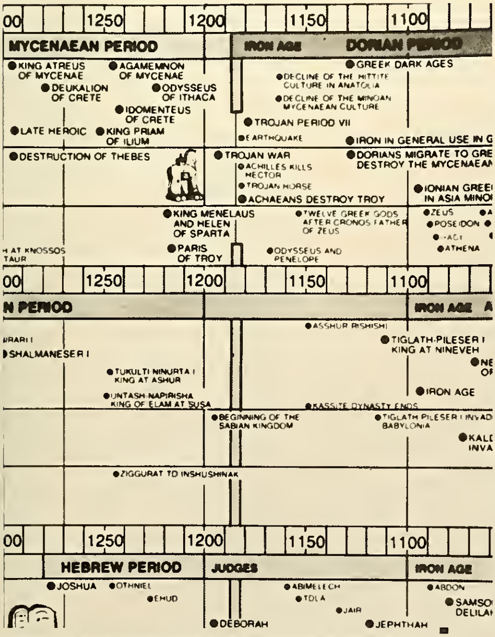
> From our work on Cynipidae, in connection with a study of the published work in other fields of taxonomy, I propose to attempt a formulation of the philosophy of taxonomy, its usefulness as a means of portraying and explaining species as they exist in nature, and its importance in the coordination and elucidation of biologic data.

Kinsey felt that he could achieve these larger goals by performing a specific study with such unprecedented factual detail that larger principles would be evident in the volume of information itself. Kinsey was a workaholic before the word was invented. On a traveling fellowship in 1919–20, he logged 18,000 miles (2,500 on foot) in southern and western regions of the United States and collected some 300,000 specimens of gall wasps. His two trips to rural Mexico and Central America in the 1930s were monuments to his insatiable industry. Still, he was never satisfied. In his 1936 monograph, he lamented that for each of his 165 species, he had collected, on average, "only" 214 insects and 755 galls. For 51 of these species (variable groups in regions of uniform topography) he stated that he would not be satisfied until he had a grand total of 1,530,000 insects and 3 to 4 million galls!

More than mere collection mania underlay Kinsey's expressed desires and actual efforts. A modern statistician might well say that Kinsey had an inadequate appreciation of sampling theory; you really don't need to get every one. Still, Kinsey pursued his copious collecting because he operated and centered his biological beliefs upon one cardinal principle: the primacy and irreducibility of variation. Ironically, much of taxonomic practice had not accommodated to this fundamental change brought to biology by

THE WORLD HISTORY CHART

History comes alive. On The History Chart.



The history shown in this block is all contained in the small square indicated on the chart above.

If you think history is just a collection of dry facts, you should send for The History Chart today. Because The History Chart (34 inches high and 8 feet long!) is a fascinating 6000 year chronology of the world's people and events to the present day. To understand the wealth of information contained in the Chart, the history of the United States is only 2 inches old over 8 feet of time.

Just ask yourself the following questions. Who came first, the Romans or the Vikings? Did the Babylonian Captivity of the Jews pre-date the Athenian Republic? Who brought the Greek gods to Egypt?

If you don't know (or even if you do), you'll find that The History Chart is a uniquely enriching educational experience for everyone. That's why The History Chart is on **permanent display in the Library of Congress.**

There's no better way to see the panorama of human history, archaeology, theology and mythology than The History Chart. It even includes suggestions for further reading.

So fill out the coupon (or write on a separate piece of paper) and send it with your check or money order for $19.95 (plus $5.00 for shipping and handling) today. You'll soon be enjoying history as you never have before.

Please send me The History Chart. Enclosed is my check or money order for $24.95 (which includes $5.00 for shipping and handling). Add $ 10 for laminated Chart.

Name ________________________

Address ________________________

City/State/Zip ________________________

Mail to: International Timeline
10560 Main St., Suite 413
Fairfax, VA 22030

Virginia residents add 4% sales tax. Please allow 4-6 weeks for delivery.

L.L.Bean®

Outdoor Sporting Specialties

Wood Carrier

Manufactured by us from heavy duck. Leather handles are rounded for a comfortable grip. A practical arrangement for carrying stove or fireplace wood. No dirt or bark on the floor with this convenient carrier. Size 20" x 42".

Please Ship Postage Paid
__________8731W Wood Carrier, $9.75

☐ Check Enclosed ☐ MasterCard®
☐ VISA ☐ American Express

Card Number Exp. Date______

☐ **SEND FREE CATALOG**

Name________________
Address________________
City________ State_____ Zip________

L. L. Bean, Inc.
781 Casco St., Freeport, ME 04033

This photograph is the Maya Crystal Skull and is an example of the subjects that you can read about in Popular Archaeology, now in its 10th year of publication. Each issue brings you "The Mystery and Excitement of the Search and Excavation." Edited by professional archaeologists, this magazine is written in an easy-to-read style and is well illustrated. You will receive articles on the pyramids of Egypt, American archaeology, Roman and Greek Archaeology, human evolution, the scientific methods used in archaeology, and notices on opportunities to do field work. Each subscriber also receives our Special Publication series, such as: New England Tomahawks, Hopewell Mounds, SE weeping eye culture, prehistoric Pueblo cultures in the SW. Subscribe to a world of archaeology for less than the regular annual subscription rate, and receive an additional free bonus of good-reading back issues. Subscription is $12.75 for one year, $19.75 for two years, and $24.75 for three years.

popular
ARCHAEOLOGY

P.O. Box 4190, Arlington, VA 22204

evolutionary theory. Many taxonomists still viewed the world as a series of pigeonholes, each housing a species. Species would be defined by their "essences"—fundamental features separating them from all others. Variation was a nuisance at best—a kind of accidental splaying out around the essential form, and serving only to create confusion in the correct assignment of pigeonholes. Most classical taxonomists treated variation as a necessary evil and often established species after studying only a few specimens.

Taxonomists like Kinsey, who centered their work in evolutionary theory, developed a radically different view of variation. Islands of form exist, to be sure: cats are not a sea of continuity, but come to us as lions, tigers, lynxes, tabbies, and so forth. Still, although species may be discrete, they have no immutable essence. Variation is the raw material of evolutionary change. It represents the fundamental reality of nature, not a mere accident about a created norm. Variation is primary; essences are illusory. Species must be defined as ranges of irreducible variation.

This antiessentialist way of thinking has profound consequences for our basic view of reality. Ever since Plato cast shadows on the cave wall, essentialism has dominated Western thought. It leads us to neglect continua and to divide reality into a set of correct and unchanging categories. It establishes criteria for judgment and worth: individual objects that lie close to the essence are good; those that depart are bad, if not unreal.

Antiessentialist thinking forces us to view the world differently. We must accept shadings and continua as fundamental. We lose criteria for judgment by comparison to some ideal: short people, retarded people, people of other beliefs, colors, and religions are people of full status. The taxonomic essentialist scoops up a handful of fossil snails in a single species, tries to abstract an essence, and rates his snails by their match to this average. The antiessentialist sees something entirely different in his hand—a range of irreducible variation defining his species, some variants more frequent than others, but all perfectly good snails. Ernst Mayr, our leading taxonomic theorist, has written elegantly and at length on the difference between essentialism and variation as an ultimate reality ("population thinking" in his terminology—see his recent book, *The Growth of Biological Thought*, Harvard University Press, 1982).

Kinsey, who understood the implications of evolutionary theory well, was a radical antiessentialist in taxonomy. His belief in the primacy of variation spurred an almost frantic effort to collect ever more specimens. His belief in continua forced him to explore virtually every square foot of suitable territory for *Cynips* in North America—for whenever he found large gaps, he strongly suspected (usually correctly) that intermediate forms would be found in some geographically contiguous area.

In the end, Kinsey's antiessentialism became almost too radical. He was so convinced that species would grade into other species that he began to name truly intergrading geographical variants *within* a single species as separate entities, and established a bloated taxonomy of full names for transient and minor local variants. (Kinsey decided that species became established by the spread through local populations of discrete mutations with small effects. Thus, whenever he found a local population differing from others by mutations of the type produced in laboratory stocks, he established a new species. But local populations within a species often establish small mutations without losing their central tie to the rest of the species—the ability to interbreed.)

More important for American social history, Kinsey transported bodily to his sex research the radical antiessentialism of his entomological studies. Kinsey's twenty years with *Cynips* were not a wasteful diversion compared with the later source of his fame. Rather, Kinsey's wasp work established both the methodology and principles of reasoning that enabled him to be a pioneer in sex research.

I am not merely making learned inferences about continuities that the master of antiessentialism didn't recognize. Kinsey know perfectly well what he was doing. He regretted not a moment spent on wasps, both because he loved them too and because their study had set his intellectual sights. In the first chapter of his first treatise on *Sexual Behavior in the Human Male*, Kinsey included a remarkable section on "the taxonomic approach," with two subheadings—"in biology," and then the explicit transfer, "in applied and social sciences." Kinsey wrote:

> The techniques of this research have been taxonomic, in the sense in which modern biologists employ the term. It was born out of the senior author's long-time experience with a problem in insect taxonomy. The transfer from insect to human material is not illogical, for it has been a transfer of a method that may be applied to the study of any variable population.

Extensive sampling was the hallmark of Kinsey's work. Most previous studies of human sex had either confined their re-

BRANDY OF LAFAYETTE
Marquis de Caussade
v.s.o.p.
FINE ARMAGNAC
APPELLATION ARMAGNAC CONTROLEE
750 ml
PRODUCE OF FRANCE
80°Proof
EAUZE

MORPHO RHETENOR. EVANESCENT, SHIMMERING BEAUTY.
SOARING TO ALTITUDES OF 3000 FEET AND ABOVE. IN A WORD: SUBLIME.

Caussade Fine Armagnac. Among France's great Armagnacs and Cognacs, the connoisseur's experience.
Infinitely softer, more composed. Possessing endless subtleties of flavour and aroma. VSOP and Extra SP. 80° proof.
Imported in limited quantities by Park Benziger & Co., Yonkers, New York 10701.

The worldwide popularity of Steiff bears keeps on growing. Collectible and lovable, they're from the creator of the original Teddy Bear, and handmade in Germany, since 1903. Ask for the authentic Button-In-Ear brand at fine toy and department stores.

Steiff
BUTTON IN EAR

The bear market is bullish.

Community Coffee
Hotel Special Blend
Net Wt. 16 oz. (1 lb.)
Community Coffee
Medium Dark Roast
regular grind
Net Wt. 16 oz. (1 lb.)
Community Coffee
Dark Roast
regular grind

SOME COFFEES YOU SAMPLE. OURS, YOU LOVE. That sample costs only $10.50, a remarkable price for a selection of three one-pound packages of one of the world's finest gourmet blends and roasts, Cap Saurage's Community Coffee—a taste that has led three generations of customers to savor and enjoy particularly flavorful lives. It is now available at selected gourmet food stores.

If you wish, we will send you this selection along with our gourmet coffee book, so you may experience the finest blends of Brazilian Santos, Colombian Medellin-Armenia and Mexican Altura coffees: an introduction to the pleasures of different roasts from a subtle light medium to the peak flavor in our dark roasted coffees.

Call Toll Free 800-535-9901 (with your Visa or MasterCard number ready) or send $10.50 with your name and address to Community Coffee Company, P.O. Box 3778, Dept. NH1, Baton Rouge, Louisiana 70821-3778. Specify choice of whole bean, regular or filter grind.

Community Coffee
BRAND®

porting to unusual cases (Krafft-Ebing's *Psychopathia Sexualis*, for example) or had generalized from small and homogeneous samples. If Kinsey had hoped for millions of wasps and their galls, he would at least interview many thousands of humans. He knew that he needed such large numbers because his antiessentialist perspective proclaimed two truths about variation for wasps and people alike—apparently homogeneous populations in one place (all college students at Indiana or all murderers at Alcatraz) would exhibit an enormous range of irreducible variation, and discrete local populations in different places (older middle-class women in Illinois or poor young men in New York) would differ greatly in average sexual behaviors. (Biologists refer to these two types of variation as within-population and between-population.) Kinsey would have to sample many differing groups and large numbers within each group. He wrote in the first paragraph of his treatise on males:

> It is a fact-finding survey in which an attempt is made to discover what people do sexually, and what factors account for differences in sexual behavior among individuals, and among various segments of the population.

And in his section on "the taxonomic approach in biology" he explained why his experience with wasps had set his methods for humans:

> Modern taxonomy is the product of an increasing awareness among biologists of the uniqueness of individuals, and of the wide range of variation which may occur in any population of individuals. The taxonomist is, therefore, primarily concerned with the measurement of variation in series of individuals which stand as representatives of the species in which he is interested.

Kinsey's belief in the primacy of variation and diversity became a crusade. His 1939 Phi Beta Kappa lecture, "Individuals," focused on the "unlimited nonidentity" among organisms in any population and castigated both biological and social scientists for drawing general conclusions from small and relatively homogeneous samples. For example:

> A mouse in a maze, today, is taken as a sample of all individuals, of all species of mice under all sorts of conditions, yesterday, today, and tomorrow. A half dozen dogs, pedigrees unknown and breeds unnamed, are reported on as "dogs"—meaning all kinds of dogs—if, indeed, the conclusions are not explicitly or at least implicitly applied to you, to your cousins, and to all other kinds and descriptions of humans. . . . A noted American colloid chemist startles the country with the announcement of a new cure

for drug addicts; and it is not until other laboratories report failure to obtain similar results that we learn that the original experiments were based on a half dozen individuals.

As a second important transfer from his entomologically based antiessentialism, Kinsey repeatedly emphasized the impossibility of pigeonholing human sexual response by allocating people into rigidly defined categories. As his wasps formed chains of continuity from one species to the next, human sexual response could be fluid, changing, and devoid of sharp boundaries. Of male homosexuality, he wrote:

> Males do not represent two discrete populations, heterosexual and homosexual. The world is not to be divided into sheep and goats. Not all things are black nor all things white. It is a fundamental of taxonomy that nature rarely deals with discrete categories. Only the human mind invents categories and tries to force facts into separate pigeon-holes. The living world is a continuum in each and every one of its aspects. The sooner we learn this concerning human sexual behavior the sooner we shall reach a sound understanding of the realities of sex.

The third transfer—and the one that ultimately brought Kinsey so much trouble—involved the contentious issue of judgment. If variation is primary, copious, and irreducible, and if species have no essences, then what "natural" criterion can we construct for judgment? An odd variant is as much a member of its species as an average individual. Even if average individuals are more common than peculiar organisms, who can say that one or the other is "better"—for species have no "right" form defined by an immutable essence. Kinsey wrote in "Individuals," again making explicit reference to wasps:

> Prescriptions are merely public confessions of prescriptionists. . . . What is right for one individual may be wrong for the next; and what is sin and abomination to one may be a worthwhile part of the next individual's life. The range of individual variation, in any particular case, is usually much greater than is generally understood. Some of the structural characters in my insects vary as much as twelve hundred percent. This means that populations from a single locality may contain individuals with wings 15 units in length, and other individuals with wings 175 units in length. In some of the morphologic and physiologic characters which are basic to the human behavior which I am studying, the variation is a good twelve thousand percent. And yet social forms and moral codes are prescribed as though all individuals were identical; and we pass judgments, make awards, and heap penalties without regard to the diverse difficulties involved when such different people face uniform demands.

Kinsey often claimed in his two great reports that he was merely recording the facts of sexual behavior without either passing or even implying judgment. On the prefatory page to his report on males, he wrote:

> For some time now there has been an increasing awareness among many people of the desirability of obtaining data about sex which would represent an accumulation of scientific fact completely divorced from questions of moral value and social custom.

His critics countered that an absence of judgment in the face of such extensive recording is, itself, a form of judgment. I think I would have to agree. I see no possibility of a completely "value-free" social science. Kinsey may have disclaimed in the reports themselves, but the statement just quoted from his 1939 essay makes no bones about his conviction that nonjudgmental attitudes are morally preferable—and his basic belief in the primacy of variation itself has evident implications. Can one despise what nature provides as fundamental? (One can, of course, but few people will be content with an ethic that rejects life and the world as we inevitably find it.)

What, in any case, is the alternative? Should we not compile the factual data of human sexual behavior? Or should people who undertake such a task sprinkle each finding with an irrelevant assessment of its moral worth from their personal point of view? That would be hubris indeed. Ultimately, however, I must confess that my approval of Kinsey, and my strong attraction to him, arises from our shared values. I too am a taxonomist.

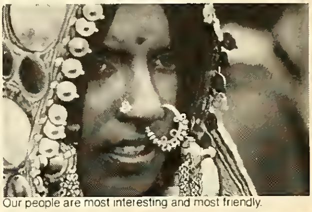
At the beginning of *The Grapes of Wrath*, as Tom Joad heads home after a prison term, he meets Casy, his old preacher. Casy explains that he no longer holds revivals because he could not reconcile his own sexual behavior (often inspired by the fervor of the revival meeting itself) with the content of his preaching:

> I says, "Maybe it ain't a sin. Maybe it's just the way folks is." . . . Well, I was layin' under a tree when I figured that out, and I went to sleep. And it come night, an' it was dark when I come to. They was a coyote squawkin' near by. Before I knowed it, I was sayin' out loud . . . "There ain't no sin and there ain't no virtue. There's just stuff people do. . . . And some of the things folks do is nice, and some ain't nice, but that's as far as any man got a right to say."

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

INDIA.
EXPECT THE
UNEXPECTED.

Climb to the top of the world



Our people are most interesting and most friendly.

Your hotel could be a lovely houseboat

"Suppose a thousand suns should rise together into the sky: such is the glory of the shape of the infinite."

Bhagavad-Gita

What you expect in India will astonish you. What you have not expected could be a turning point in your life.

Perhaps it will be the massive Konarak Temple, dedicated to the Sun God.

Or the majestic Himalayas.

It might be something as simple as the smiling eyes of our people.

Our fascinating cuisine.

Or that we have the most marvelous places for you to stay.

In India you will find a different world. An unexpected world. See your travel agent.

UNBELIEVABLE
INDIA

Please send me information on Unbelievable India. NH-12

Name

Address

City, State, Zip

GOVERNMENT OF INDIA TOURIST OFFICE
30 ROCKEFELLER PLAZA NEW YORK N.Y. 10112 (212) 586-4901
3550 WILSHIRE BLVD., LOS ANGELES CA 90010 (213) 380-8855
523 37TH AVE., SAN FRANCISCO, CA (415) 386-8284
230 N. MICHIGAN AVE., CHICAGO, IL 60601 (312) 236 6899
POST BOX 342 T.D. CENTRE, TORONTO, CANADA (416) 362-3188
MIAMI FLA (305) 944-7039 DALLAS TEXAS (214) 234-2233

HAWAII Showcase of Evolution

An introduction by Hampton L. Carson

Nearly a hundred and fifty years ago, Charles Darwin visited the Galápagos, a group of isolated, volcanic tropical islands, similar in many ways to Hawaii. He wrote in his diary:

> Seeing every height crowned with its crater, and the boundaries of most of the lava-streams still distinct, we are led to believe that within a period, geologically recent, the unbroken ocean was here spread out. Hence, both in space and time, we seem to be brought somewhat near to that great fact—that mystery of mysteries—the first appearance of new beings on this earth.

His observations were made mostly of two groups, the birds and the reptiles. H.M.S. *Beagle* did not stop in Hawaii; if it had, Darwin would have encountered evidence of island evolution that far outstripped what he saw in the Galápagos.

Descent with change is the basic law of life, comparable to the laws of Newton and Einstein. A major interest of the life sciences in this century is to decipher exactly how the process works. What are the rules of change in the hereditary material as descent occurs? To what extent is genetic change slow or rapid and how may we get further evidence on the workings of Darwin's central principle, natural selection?

The small sampling of Hawaii's unique plants and animals described in this issue not only illustrates the dramatic manifestations of evolution on these islands but also suggests how much we may yet learn. Modern biology is now equipped with ecological, genetic, molecular, and statistical tools that can provide answers to the deepest questions we can ask about life on earth.

The eight major islands of Hawaii lie in the tropics of the central Pacific, forming an almost straight line for 400 miles from northwest to southeast. All are volcanic in origin, having been thrust up from the deep floor of the ocean; they are isolated from the continents by more than 2,000 miles.

At the north end lies the relatively old island of Kauai. The top of its volcano has been flattened by nearly six million years of erosion, caused by heavy rainfall brought by the trade winds. Despite this,

ED COOPER PHOTO

LE MONNIER

Kauai
Niihau

Oahu
Molokai
Maui
Lanai
Kahoolawe

the summit is still about 5,000 feet above sea level. Kauai's boggy plateau, filled with luxuriant vegetation, has been invaded by the steep canyons of its rivers. These, in turn, have contributed to the buildup, over the millennia, of glorious sand beaches.

To the south, the islands are successively younger. Maui was formed from two volcanoes. The older one to the north has moderately eroded canyons and substantial beaches. The newer, southeast end is a massive mountain, 10,000 feet high. On some of its slopes, its newness is apparent, and one can make out the outlines of only sparsely vegetated flows of lava, some of which were molten only a few hundred years ago.

At the south end of the archipelago lies Hawaii, locally called the Big Island to distinguish it from the island group as a whole. Despite its large size, there are few rivers or beaches. The savage lava shores and snow-capped volcanic domes reaching about 14,000 feet reflect its relative youth—only about three-quarters of a million years at the oldest end. Two of its five volcanoes are currently active.

All the islands are covered with diverse forests; those of the dry sides, which are sheltered from the trade winds, differ greatly from the rain forests on the northeastern, or windward, sides. The plants are a fascinating mixture of oddities whose ancestors drifted in, over millions of years, from all points of the compass in a series of accidental introductions. The native animal life of Hawaii arrived in a similar manner. Indeed, time, chance, and isolation are the main forces that have shaped the life forms of Hawaii. Before the arrival of humans, only about a thousand years ago, there were no large mammals browsing the forests or grazing the grasslands. There were also no reptiles, and the birds were limited to a curious collection of species, including an amazing family of finches called the honeycreepers. Certain insect groups and land snails enjoyed exuberant development.

The evidence is clear that these life forms arose from the chance arrival of individuals. In some instances, they came all the way from the continents on the fringe of the Pacific Ocean. What especially interests biologists is the extensive genetic evolution that has obviously been undergone by the populations descended from these founders. In most cases, new species with unusual body forms adapted to their new habitats have arisen. As a result, most of the animal and plant species of Hawaii—numbering in the hundreds in some groups—are found nowhere else in the world.

Imagine the excitement of the biologists who first came upon some of these new species: the tree violets, the predatory inchworms, the blind crickets in lava caves, or the remarkable six-foot-high silverswords, a kind of tarweed growing on the cinders of the high volcanic slopes.

Fascinating questions crowd the mind. Where did these organisms come from and what were their ancestors like? How long ago did they arrive and how did they make it across thousands of miles of ocean? The geneticist wants to go a step further: how and why have the genes in their populations changed to meet the new ecology that they encountered? Why have some descendant lines, like the strange upland goose, remained as just a single species, whereas others, like some of the small moths, have radiated into as many as a thousand new species? The list of challenges to the researcher is a long one.

The islands are an extraordinary natural laboratory for population and evolutionary studies. The continents are the old land; most of their evolutionary novelties began and were completed eons ago. Hawaii is the new land; the same processes that produced continental life are being rerun in this microcosm and are open to study right now. This point was argued eloquently by the entomologist Elwood Zimmerman in 1958, when he attempted to tell the world about the geneticist's favorite: *Drosophila* flies. He wrote:

> Since I became aware, many years ago, of the astonishing development of *Drosophila* in Hawaii, I have tried to interest geneticists and evolutionists in the fauna. I fear that it has been considered . . . that my descriptions of the size and diversity of the fauna are exaggerated. I do not exaggerate; the fauna is extraordinary! . . . In Hawaii is found a range from unusually small species to absolute giants up to about a centimeter across . . . there may be as many as 300 species concentrated in an area smaller than the little state of Massachusetts. . . . Where else has such a drosophilid fauna developed? Is this fauna not worthy of detailed attention by those equipped to do advanced research on the genetics and evolution of this group of fascinating flies?

By now, Zimmerman's call has stimulated a lot of new research, and not only on the *Drosophila* flies. Of course, finding and describing the new plants and animals must come first. But behind these exciting discoveries lie the great basic questions of biology first raised by Darwin. The detailed way in which adaptations occur and species are formed has always seemed a mystery. Remarkable progress has recently been made in reducing the problem of the origin of species to understandable genetic processes. Nowhere is there a better opportunity to catch nature at work than in Hawaii. □

RESERVATION APPLICATION

Brrrrr!

Must be postmarked by
December 31, 1982.

World Wildlife Fund
C/o Franklin Porcelain
Franklin Center, Pennsylvania 19091

Please accept my reservation for *Brrrrr!* by Eva Dalberg. This original sculpture will be crafted for me in fine hand-painted porcelain.

I understand that I need send no money at this time. I will be billed in three monthly installments of $15.* each, the first payment due before the work is sent to me.

**Plus my state sales tax and a total of $2.50 for shipping and handling.*

Signature______________________________

ALL ORDERS ARE SUBJECT TO ACCEPTANCE.

Mr./Mrs./Miss______________________________

PLEASE PRINT CLEARLY

Address______________________________

City______________________________

State, Zip______________________________

Limit: One sculpture per person. A 30

© 1982 FP

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

YO

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 1 FRANKLIN CENTER, PENNSYLVANIA

POSTAGE WILL BE PAID BY ADDRESSEE

FRANKLIN PORCELAIN
Franklin Center, Pennsylvania 19063

B

World Wildlife Fund announces an original work of art in fine, hand-painted porcelain.

Brrrrr!

New work in the distinguished series
of baby animal sculptures
in porcelain from the World Wildlife Fund.

Issued in a limited edition.

Art of unusual beauty and charm at the very attractive price of $45.

For the first time in its history, the World Wildlife Fund has undertaken the creation of a collection of porcelain sculptures of baby animals.

Brrrrr!, portraying a delightful polar bear cub, has just been completed for this collection. It is crafted in hand-painted porcelain and will be issued at the very modest price of $45—which itself may be paid in convenient monthly installments of $15 each.

This new and original work of art has been designed for the World Wildlife Fund by Eva Dalberg, one of the world's most talented portraitists of animals. Dalberg was chosen for this commission because she has the unique ability to capture the lovable quality of animals.

Here the little polar bear is portrayed in an amusing situation—"testing" the water to see if he *really* wants to go in! This delightful sculpture will be crafted in fine porcelain and completely hand-painted. So, every feature and color will be bright, clear and crisp. The polar bear's white furry coat, his sparkling black eyes, his chubby little paws—and that slightly hesitant expression on his face.

Brrrrr! will be crafted for the World Wildlife Fund, under the supervision of Franklin Porcelain.

Each imported sculpture will be backmarked with the official "WWF" symbol. In addition, a Certificate of Authenticity attesting to its official status and bearing the signature of the Director General of World Wildlife Fund-International, will be included.

In the tradition of classic works in fine porcelain, this appealing sculpture will be made available in a limited edition, reserved exclusively for those who place their orders during 1982. After that time, no further orders for this work will be accepted and the edition will be permanently closed.

You will enjoy displaying this enchanting polar bear cub in your home and showing it to all your friends. It will be a conversation piece you will treasure. And you will have the satisfaction of knowing that it is created in a long-established tradition. For, of all porcelain pieces collectors most prize, small figures of animals are among the most popular.

To reserve *Brrrrr!* by Eva Dalberg, you must act promptly. Please be sure that your reservation application is sent to World Wildlife Fund, C/o Franklin Porcelain, Franklin Center, PA 19091, no later than December 31, 1982.

SHOWN ACTUAL SIZE

© 1982 FP

RESERVATION APPLICATION

Brrrrr!

World Wildlife Fund
C/o Franklin Porcelain
Franklin Center, Pennsylvania 19091

Must be postmarked by December 31, 1982

Please accept my reservation for *Brrrrr!* by Eva Dalberg. This original sculpture will be crafted for me in fine hand-painted porcelain.

I understand that I need send no money at this time. I will be billed in three equal monthly installments of $15.* each, the first payment due before the work is sent to me.

**Plus my state sales tax and a total of $2.50 for shipping and handling.*

Signature____________________
ALL ORDERS ARE SUBJECT TO ACCEPTANCE.

Mr./Mrs./Miss____________________
PLEASE PRINT CLEARLY

Address____________________

City____________________

State, Zip____________________

Limit: One sculpture per person.

The First Arrivals

Hawaii's first plant and animal colonizers traveled great distances across the sea, carried by water, wind, and birds

by Sherwin Carlquist

Grand in size compared with most volcanic islands, brushed by abundant rains, the islands of the Hawaiian chain are ideal for luxuriant growth of plants and for rich assemblages of animals within their forests. Yet when they emerged from the sea, the Hawaiian Islands were isolated from any continent by vast stretches of ocean. Looking even further back in time, we find that the predecessor islands to the west, now atolls or submarine mountains, were themselves never linked with continental land. How did life cross these formidable stretches of sea and take hold?

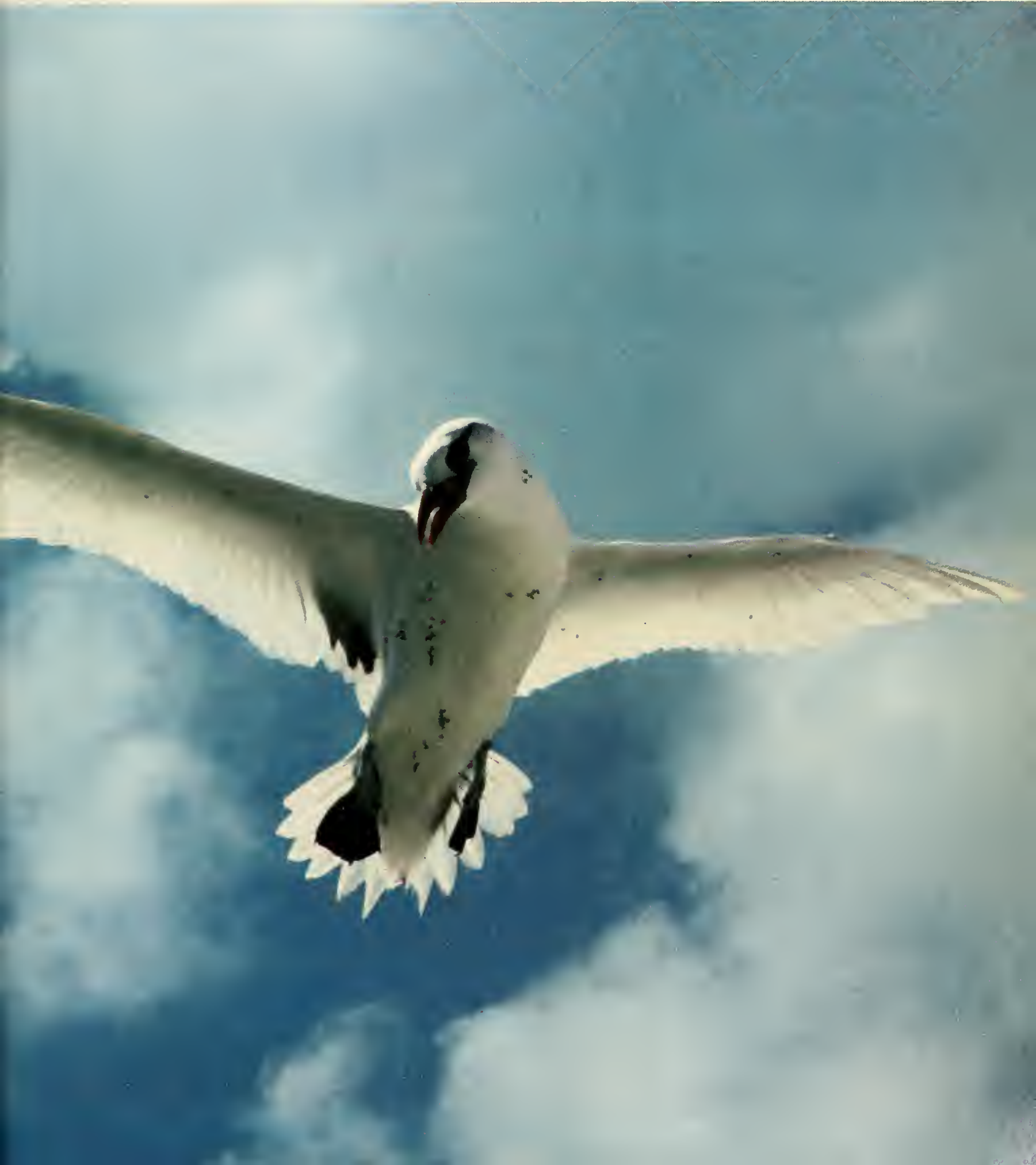
The species now living on these islands form the silent archives of what happened, offering mute testimony to the effectiveness of long-distance dispersal by chance. But how did these chance migrations take place, and what features visible on these organisms today provide traces of the mechanisms of dispersal? Can we discover how a few events, some less than a million years ago, must have occurred?

If a scattering of chance dispersal events has resulted in the present flora and fauna, such events must be so infrequent that we really cannot expect to observe any natural arrivals today. Indeed, if dispersal to the Hawaiian Islands were frequent, species there would be the same as in the source areas. A constant stream of immigrants would prevent distinctively Hawaiian plants and animals from ever evolving, for new species are evolved in isolation. We can see this on islands separated from mainland areas by only short distances. On the Florida Keys, for example, no assemblage of endemic plants or animals has evolved.

Distance is not the only requirement for speciation. Few new species would have evolved on the Hawaiian Islands if, like atolls, they were low islands with limited habitat diversity. The habitats of the Hawaiian chain, however, are extraordinarily rich. In the lowlands there are coral sand beaches, coral pavement (coral reef areas raised above sea level), and, on the lee sides of some islands, slopes with as little as twelve inches of rain per year. On the wet sides of the islands, lowlands may receive more than one hundred inches of rain annually. The uplands are moist, al-

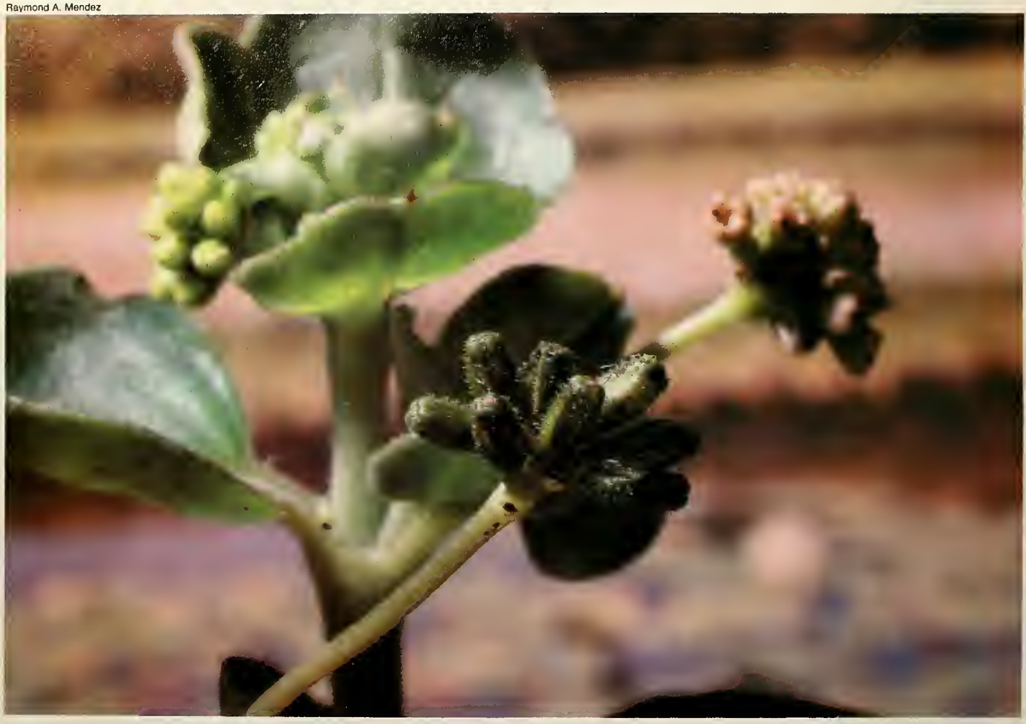
As dispersal agents, birds may carry seeds and fruits on the outside of their bodies or in their digestive tracts. Sea birds eat little plant food, but they may encounter vegetation during migration or around their nest sites. This tropic bird is spotted with seeds.

David Cavagnaro



Plants in the genus Boerhaavia, *found on coral beaches, bear sticky fruits a few inches above the ground. When a bird brushes up against a plant, it picks up fruits. Later, often as the bird preens itself in a new location, the fruit is dislodged and dispersal is accomplished.*

Raymond A. Mendez



though where there is new lava, the ground is barren and sunbaked. Deep soil on older island areas may bear dense woodland. At elevations near 6,000 feet, annual rainfall may climb as high as 500 inches and bogs occur. As the volcanic slopes rise above 6,000 feet, they become drier and may be snow covered in winter.

So many, and often so favorable, are these habitats that one might think they could support an endless variety of animals and plants. Weedy plants, such as lantanas or guavas, and weedy animals, such as mynas and mongoose, which were introduced to the Hawaiian Islands by humans and which now thrive there, are an indication of the variety and abundance of organisms that can live and reproduce on the islands. In prehuman times, however, these now rampant types were absent. Natural dispersal to islands is a bottleneck through which a relatively small number of plants and animals can pass—only those preadapted to transport across long distances of ocean. Moreover, even after an organism is safely deposited on Hawaii, it will die or fail to reproduce unless the habitat it finds itself in closely matches the one it came from. Inhospitable environments can be an even greater obstacle than the rarity of chance dispersal.

How many successful immigrants were there? To answer this question, we can group those species likely to have stemmed from a single ancestor. For example, the twenty-odd species of Hawaiian honeycreepers belong to a family of birds known only from Hawaii. No other birds are closely related to them. Therefore, the only reasonable hypothesis is that all the species arose from a single successful colonization by an ancestral type. Using this method and taking into account the growing number of extinct bird species in the fossil record, biologists have estimated that at least 15 successful colonizations led to 80 or more native species of land birds (wading birds excluded); all but some 40 species are now extinct. Similarly, about 20 land mollusk colonizations appear to have yielded the thousand or so species now native, and about 250 insect immigrants produced the 4,000 native insect species. Only one successful mammal immigrant (a bat) can be hypothesized. The approximately 1,800 species of flowering plants can be traced to more than 250 original immigrants, and the 168 ferns stem from 135 colonists. These numbers tell us something about the relative ease of dispersal: flowering plants and insects, for example, are excellent at dis-

IT TAKES 12.2 MONTHS TO MAKE ENOUGH FOR A NEW CAR. FORTUNATELY THERE'S ONE THAT'S WORTH IT.

Statistics show that it takes a full year to make enough to buy a new car.*

After all those desk top lunches, all those endless meetings, all that running and sweating and worrying and overtime, you'd better be sure of the car you buy.

You can't afford a mistake.

Maybe that's why statistics also show more people than ever have been buying Volvos.

Volvos give you a lot for each hard earned buck. All come loaded with standard features. All are a genuine pleasure to drive (a rarity in this age of econobox boredom). And all are built to live the long life that Volvo has become famous for. Volvo's life expectancy is now one third longer than the average of all other cars on the road.†

Which means instead of spending your salary on another new car just a few years from now, you can spend it on something truly wonderful.

A vacation from work.

VOLVO
A car you can believe in.

*Based upon 1981 average household discretionary income and average selling price of new cars from N.A.D.A. †Analysis conducted by Ken Warwick & Associates, Inc. Based on a comparison of U.S. registration data for Volvo and for the automobile industry as a whole and not by individual make. This is not, however, an expressed or implied warranty, but it's comforting to know. © 1982 Volvo of America Corporation.

persal, whereas mammals are very poor.

What can we learn about what makes organisms good or poor at dispersal, and how might the ancestors of Hawaii's plants and animals actually have dispersed? What can we do that will tell us how a seed might have dispersed millions of years ago? There are no ways of watching a dispersal event, which may begin with a bird picking up a seed on one island and depositing it on another in just the right spot for it to germinate, produce flowers and fruits, and reproduce. Nevertheless, present-day fruits and seeds in the native Hawaiian flora can give us hints. In the course of evolution, fruits and seeds do sometimes change, and some Hawaiian plants have lost a portion of their dispersal capability. Overall, however, relatively little change has occurred. Most Hawaiian seeds and fruits closely match those of their closest relatives on mainland areas, so the mechanisms by which they disperse are presumably much like those that brought them to the islands many years ago. If particular groups of Hawaiian plants are similar to some mentioned in studies of dispersal, such as Henry N. Ridley's encyclopedic work *Dispersal of Plants Throughout the World*, we have a beginning hypothesis on how dispersal may have occurred.

Observing Hawaiian flora to see if those dispersal mechanisms go on today, however, is not easy. The birds that typically eat the berries of a particular shrub may no longer be living in the area we choose to observe, or introduced birds, instead of native ones, may be seen to eat the fruits. Perhaps these berries are dispersed by only a few birds visiting for a few hours during one day—at a time when an observer is not there. In that case, we might try comparing the berries with other fleshy fruits known to be eaten by Hawaiian birds to see if size, color, and texture are similar. We can link such facts into a web of circumstantial evidence. To firm up the evidence, we might even experiment by feeding berries of a Hawaiian plant to a migratory shorebird. If the bird accepted them as food, we could see how long the seeds were retained inside the bird and whether they were capable of germinating when excreted. Trapping and caging Hawaiian birds for such purposes is illegal, however, and keeping them would be expensive and difficult. So the web of evidence may be weak—but linking present evidence with events that happened in the dim geologic past often involves small shreds of evidence.

Fortunately, some experiments are less difficult to carry out than others. Experiments on whether seeds and fruits in the Hawaiian flora can float in seawater, for instance, are easy to do. As early as 1906, Henry B. Guppy did just that, floating seeds in jars of water for months at a time. That some seeds float readily in seawater can also be seen by a walk along a beach. Tropical shores in particular are sometimes covered by seeds, fruits, and various plant "trash" carried by waves and beached at high tide. When planted and watered with fresh water, many of these seeds germinate even though they may have spent months afloat.

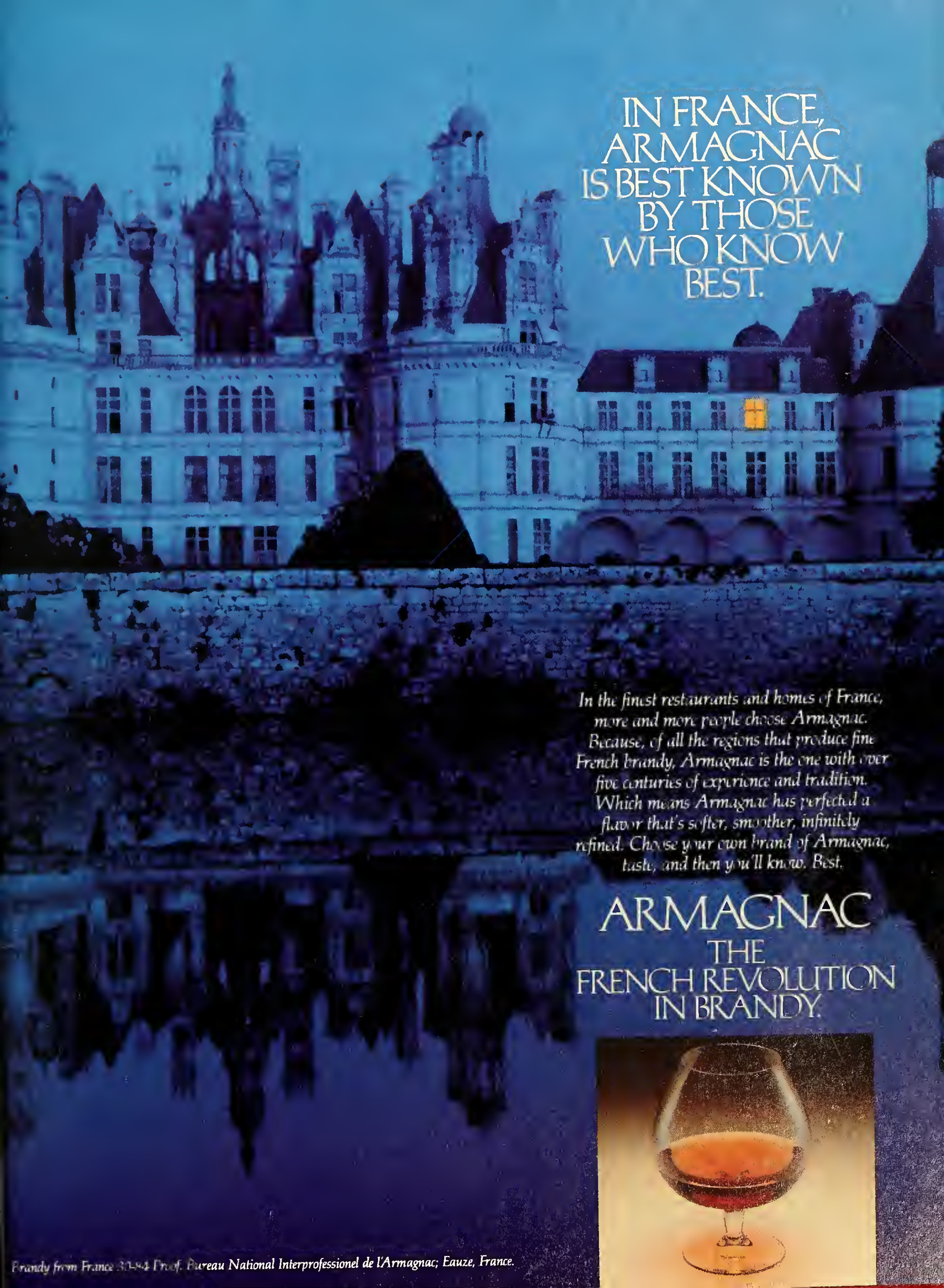
Have these capabilities made seawater-drifted seeds responsible for much of the colonization of Hawaii by plants? Surprisingly, only a small proportion of Hawaiian plants appear to have arrived this way: flotation experiments suggest that less than a fifth of the hypothetical plant immigrants might have reached these mountainous, volcanic islands in this manner. A look at the seeds of plants growing in another Pacific environment—atolls—can help explain this small proportion. Most atoll plants have seeds that do float. The reason is fairly simple. An atoll is nothing more than a sunbaked, mid-ocean beach, and most seeds that float are produced by beach plants. These plants, and their seeds, are adapted in many ways to beach life but not to life in upland areas. Seawater flotation is only one of these adaptations, but beach plants do not easily escape from a syndrome in which many features related to success on beaches are grouped together. Thus, most species that arrived on Hawaii as floating seeds were—and have remained—beach plants.

A few Hawaiian plants with seashore ancestry have escaped from the beach syndrome, and these not only now have adaptations for growth in inland forests, they also have seeds that no longer float. Once a species has adapted to nonsaline upland soils and has leaves suitable for life in the shade of forests, its dispersal mechanism must enable it to reach more such spots. If its seeds still floated, they would be washed down to the sea and would float to beaches where an upland plant could not live. Thus during many years of adaptations to forests, selection has favored the loss of floating seeds.

With these few exceptions, however, the rule holds: once a beach species, always a beach species. This rule is enforced by the very ease with which seeds of beach plants float. Each year the tides bring swarms of seeds onto Hawaiian shores; many will be seeds of plants already living there. If the new seeds grow, the plants they produce can flower and interbreed with the already established individuals of the same species. This interbreeding reinforces adaptation to the beach habitat. A few genes that would permit life inland appear from time to time, but they are wiped out by each wave of new immigrants with genes only for beach life.

The major agents for the arrival of the seeds and fruits that colonized the islands' inland and upland areas were migratory birds: an estimated three-quarters of Hawaiian plant colonizers were carried, one way or another, by birds. Most of the birds whose migration route takes them by the Hawaiian Islands are shorebirds, but there are also a few sea birds, such as terns, or waterfowl, such as ducks, that sometimes visit the islands during migration. One problem with thinking of these migratory birds as plant dispersers is that the birds need a rich diet of fish and other marine animals, so they tend to follow shorelines and eat little plant food. Some plants, however, can hitch onto the outer surfaces of birds, and both shorebirds and sea birds also frequent inland areas. The seeds and fruits of plants growing in these areas can travel long distances by clinging to bird feathers in two ways: by stickiness or by means of hooklike devices.

Stickiness may be a matter of resinlike or gelatinous materials formed on seeds. For example, the pepperweed *Lepidium*, a common herb in the Northern Hemi-



IN FRANCE,
ARMAGNAC
IS BEST KNOWN
BY THOSE
WHO KNOW
BEST.

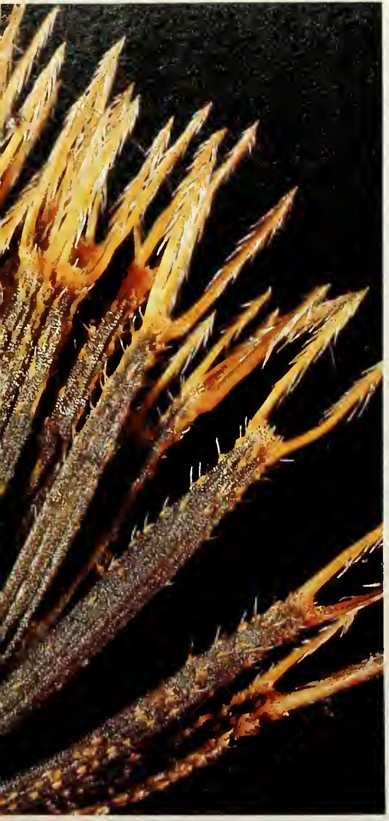
In the finest restaurants and homes of France, more and more people choose Armagnac. Because, of all the regions that produce fine French brandy, Armagnac is the one with over five centuries of experience and tradition. Which means Armagnac has perfected a flavor that's softer, smoother, infinitely refined. Choose your own brand of Armagnac, taste, and then you'll know. Best.

ARMAGNAC
THE
FRENCH REVOLUTION
IN BRANDY.

Brandy from France 80-84 Proof. Bureau National Interprofessionel de l'Armagnac; Eauze, France.

Many species of Bidens, *or beggar tick, originally hitched a ride to Hawaii as fruits or seeds hooked onto bird feathers. The fruits of* B. pilosa, *a species introduced by humans, show the barbed prongs that enabled many of its relatives to reach the islands without human help.*

Sherwin Carlquist



sphere with one species in Hawaii, has seeds whose surfaces swell into mucilaginous coverings when wet. *Lepidium* may be found growing on mud flats where migratory birds land to feed on small organisms. As they feed, the birds may inadvertently pick up the gelatinous seeds. Sticky seeds or fruits account for a little more than a tenth of the hypothesized plant immigrants to Hawaii.

Hooklike devices occur on the fruits of the beggar tick (*Bidens* spp.), a common weed in North and South America with species in Hawaii. Each small dry fruit bears prongs with backward-pointing spiky hairs, and the body of the fruit has stiff, upward-pointing hairs. No matter which way this fruit is inserted into feathers, it will stay firmly. This efficient dispersal mechanism probably evolved on mainland areas for transport not on bird feathers but on the fur of mammals. In weedy plants, mechanisms to hitch fruits onto fur are favored: habitats suitable for these plants are widely scattered, so that any device that catches on the fur of a roaming animal permits the plants to reach more habitats and reproduce more abundantly. Because the texture of feathers is similar to that of fur, the fruit of *Bidens* turns out to be preadapted to transport over water on bird feathers.

Hitching a ride on a migrating bird is a relatively secure way to assure arrival on land. Oceanic drifts or air currents might carry seeds right past the Hawaiian Islands, but migratory birds fly from one land area to another. At the end of a flight, a bird is apt to preen its feathers, depositing the fruit or seed wherever it has stopped to feed or breed. For example, *Bidens*, with its easily attached fruit, is represented on numerous islands in the eastern Pacific, and its widespread distribution is probably the result of several arrivals from North and South America. Another tenth or more of the hypothetical Hawaiian plant immigrants may have hitched onto bird feathers by means of barbed, bristly, or hooked fruits or seeds.

An even larger portion—nearly 40 percent—was brought by birds that fed on the plants' fleshy and brightly colored fruits, which contained small- to medium-sized seeds. A walk through a Hawaiian forest suggests that birds fond of such fruits must have visited Hawaii and must be living there today. But most migratory birds do not eat fruit, and most fruit-eating birds do not migrate, which seems to suggest an impasse. The exceptions are what interest us, however, and although only a limited number of shorebird species migrate from America or Asia to Hawaii each year, the number of individual birds within those few species is quite large. Shorebirds feed predominantly on marine life, but repeated observations prove that a predictable, if small, portion of their diet consists of fruits. They have even been found to eat hard seeds, such as those of sedges, which probably give them little nutrition. Despite their name, shorebirds may go well inland to feed, making dispersal of inland plants by them a real possibility.

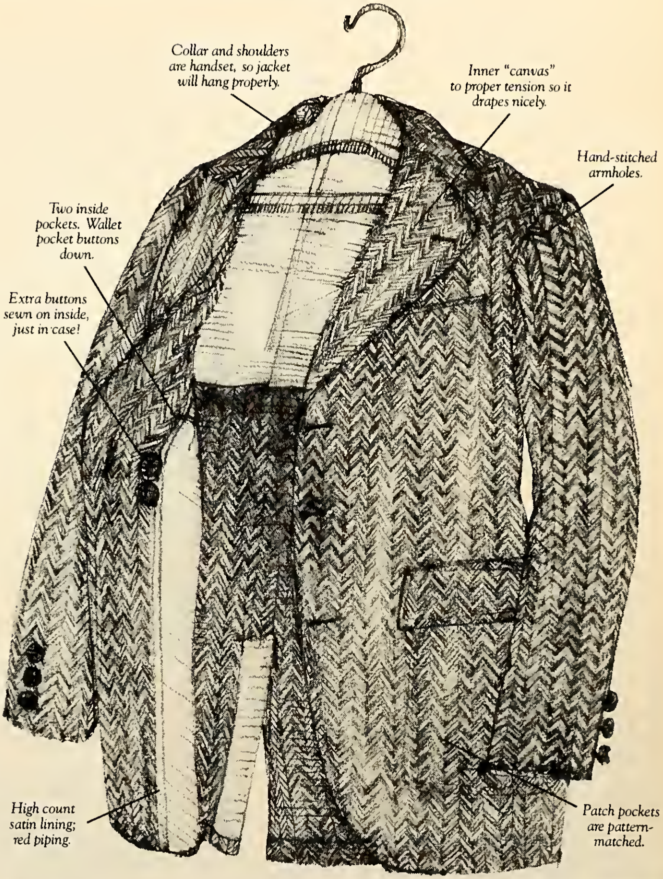
Experiments showing that shorebirds can effectively transport seeds were done in 1968 by Victor de Vlaming and Vernon W. Proctor. They found that one species, the killdeer (*Charadrius vociferus*), will accept plant foods readily. Penned killdeer retained seeds for up to 120 hours. Shorebirds are known to fly at speeds of 48 to 60 miles per hour, so that a bird flying nonstop at optimum speeds could carry a seed several thousand miles, more than the distance between Hawaii and other Pacific islands or between the North American mainland and Hawaii.

However feasible, travel of fruits and seeds inside or on birds is apparently less frequent than drift of seeds in the ocean, so why should it account for the arrival of so many plant species? The answer lies in Hawaii's ecology. Like other wet forest areas in the Pacific, Hawaii's uplands show a predominance of colorful fleshy fruits adapted for bird dispersal. These forests cover far more area than do the beaches and are capable of supporting more species. The beaches' more limited habitats tend to become filled with species relatively quickly, and opportunities for new colonists there tend to decrease.

A smaller proportion—not much more than a tenth—of the original Hawaiian plant immigrants carried by birds appears to have had very small seeds. These seeds, while not sticky or hooked themselves, may have become caught in crevices of a bird's feathers, for example, or attached by mud to a bird's foot. Another tenth of the hypothetical immigrants apparently had seeds that were resistant to seawater but unable to float. These may have arrived as parts of floating mats of vegetation, which are often seen near the mouths of rivers and can be washed out to sea during heavy rains.

If they are small enough, seeds can float in the air, but since only a little more than one percent of the Hawaiian flowering

When we found we could offer this quality herringbone jacket for only $115, we got into traditional clothes.


Collar and shoulders are handset, so jacket will hang properly.
Inner "canvas" to proper tension so it drapes nicely.
Hand-stitched armholes.
Two inside pockets. Wallet pocket buttons down.
Extra buttons sewn on inside, just in case!
High count satin lining; red piping.
Patch pockets are pattern-matched.

What first led us to think about tailored clothing was your active response to our Oxford button downs, our Lands' End knit ties, and other classic items like our Lands' End turtlenecks.

We reasoned you might like suitable jackets to wear over these items, *provided* —and this was a big "if"—we could offer them with the kind of quality features you expect from Lands' End, and at Lands' End prices.

Then we went to work.

We sent our buyers on the prowl for fabrics. We challenged our tailors to add quality features, not eliminate them for cost reasons. And, finally, we encouraged them to practice their Old World tailoring skills; and how they responded when they realized we were serious!

The results are now in.

The herringbone classic described above is typical of what Lands' End now offers in our *Charter Collection.* A small but excellent group of traditional jackets, plus some well-tailored slacks that harmonize with them, and some appropriate shirts and ties.

There's no way we can properly describe the look and feel and fit of this clothing. You need to experience it, yourself. Even then you'll find it hard to believe prices like $95 for a serviceable corduroy jacket, to $148.50 for a glen plaid import.

Open our catalog.

See the complete *Charter Collection* in our Winter Catalog. Shop us for sweaters, ski wear, deck wear and soft luggage, too. And, remember, everything Lands' End offers carries our incredible guarantee:

> *"If you are not completely satisfied with any item you buy from us at any time during your use of it, return it and we will refund your full purchase price."*

Send the coupon for a free catalog or call for one toll-free at 800-356-4444 (except in Wisconsin where the number is 608-935-2788). One of our 86 operators will answer you in person, 24 hours a day.

LANDS' END
DIRECT MERCHANTS
of fine wool and cotton sweaters, Oxford buttondown shirts, traditional dress clothing, snow wear, deck wear, original Lands' End soft luggage and a multitude of other quality goods from around the world.

☐ **Please send free 100-page catalog.**

Lands' End Dept. P-06
Dodgeville, WI 53533

Name ______________________

Address ______________________

City ______________________

State ____________ Zip ____________

Or call Toll-free:

800-356-4444

P.S. Please call after 5 p.m.

Both the seeds and the white fruits of Hawaii's beach-living Scaevola taccada *float in seawater. The vast majority of plants in the family to which* Scaevola *belongs grow in Australia, making it almost certain that the species drifted to the islands from the South Pacific.*

Raymond A. Mendez

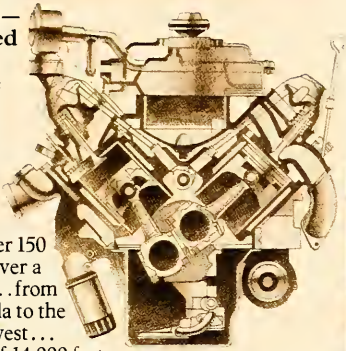
plant colonists arrived in this way, air currents do not seem to have been a very successful means of travel. Apparently, Hawaii is too far away from source areas and the air currents are too cold for seeds to survive. Fern spores, on the other hand, survive cold very well, and they are also much smaller than seeds. The 135 kinds of ferns that produced the 168 species of ferns now native to the Hawaiian Islands may well have arrived as floating spores.

What ways do we have of tracing travel by animal groups to the Hawaiian Islands? As with plants, the vast majority of animals present on the islands today are descended from ancestors with good dispersal capabilities. The abundance of possible insect immigrants was dramatized by entomologist J. Linsey Gressitt of the Bishop Museum of Honolulu. With his coworkers, he set up insect-trapping nets on ships far from land. Surprisingly, many insects were netted. Gressitt also chartered an airplane and equipped it with net-covered air intakes. Thousands of feet above land, the nets collected insects and spiders. The air was loaded with more insects than anyone had imagined. Two additional important facts emerged. First, the insects and spiders, no matter where collected, belonged to much the same families found on the Hawaiian Islands. Second, they were small, as are most insects native to Hawaii. Gressitt concluded that the Hawaiian insect fauna is an assemblage of the best travelers and that the majority of Hawaiian insects arrived by flotation in air. Only very small insects and spiders have buoyancy characteristics (high surface to weight ratios) suitable for flotation over long distances. The insects Gressitt netted were never found alive, but that was due to impact with the nets. There is no reason to believe that only dead insects float in the air, and if there is an abundance of air-buoyant insects over the Pacific, massive weather fronts or even jet streams will eventually carry some to the Hawaiian Islands.

Some Hawaiian insects, notably dragonflies and butterflies, look too large to float in air. These sturdy insects, however, are capable of long flights and are known to migrate across the water. Both dragon-

The V6 diesel Oldsmobiles:

Backed with 4 million miles of testing. And a 3-year/50,000-mile limited warranty.



In the lab and on the road—the most thoroughly tested engine ever offered by Oldsmobile. V6 diesels were run non-stop...24 hours a day ...six days a week...for nearly two months. In all, over 1,000 hours of dynamometer testing of the V6 diesel.

Three years of on-the-road testing. Six fleets of over 150 diesel V6 vehicles were tested over a 3-year period...coast to coast...from near-arctic conditions of Canada to the desert conditions of the Southwest...from a Rocky Mountain high of 14,000 feet to the busy streets of New York.

In all, over 4.1 million miles of testing.

Innovative engineering makes it a different kind of diesel. First, it features a "V" configuration for performance, smoothness and impressive drivability. A Fast-Start Glo-Plug System provides quick starts—even in 0°F weather. Other features include a water/fuel separation system and roller hydraulic lifters.

The economy of a compact in a roomy, comfortable Olds makes it a solid value. Fuel economy—without compromising room and comfort. That's the Olds point of view. Check these EPA estimates for a diesel V6 Cutlass Ciera.

Available V6 Diesel	EPA Est. Mpg	Est. Hwy.	Est. Range	Est.* Hwy. Range
Cutlass Ciera	28	43	459	705

Easy for a mid-size car like Cutlass Ciera, you say. Well, look at the figures for a full-size Ninety-Eight Regency with diesel V8.

Available V8 Diesel	EPA Est. Mpg	Est. Hwy.	Est. Range	Est.* Hwy. Range
Ninety-Eight Regency	22	38	594	1026

Behind the wheel, you could forget it's a diesel. Surprisingly smooth, impressively quiet. At cruising speed, only the slow moving fuel gage reminds you that you have a diesel up front.

Maintaining a diesel-equipped Olds. That's easy. No spark plugs. No carburetor. No distributor. Simply change oil and oil filter every 5,000 miles and check the crankcase ventilation every 15,000 miles. Other than that, it's like servicing any other new Olds. As for filling the fuel tank, you'll find that diesel fuel is now readily available across the country.

V6 or V8, between them, there's a diesel Oldsmobile to fit your needs. For 1983, Olds offers 20 ways to make a practical buying choice, while stretching out in the lap of Olds luxury. Choose from Cutlass Ciera, Cutlass Supreme, Delta 88, Ninety-Eight Regency and Toronado. There's a size and price for you.

New 3-Year/50,000-Mile Power Protection Plus limited warranty on diesel engines. An impressive engine, backed with an impressive warranty. After the first 12 months/ 12,000 miles, the warranty is subject to a deductible. See your Olds dealer for details.

More good news: New lower prices for 1983! You'll find new lower diesel engine prices across the board. Two hundred and seventy-five dollars less for the V6...one hundred twenty-five dollars less for the V8, based on manufacturer's suggested retail prices compared to last year.

A diesel Oldsmobile is a better value than ever. Test drive one at your Oldsmobile dealer.

For more information, write:
Dept. D, Oldsmobile Division,
920 Townsend, Lansing, MI 48921.

GM
MARK OF EXCELLENCE

OLDSMOBILE

America's #1 seller of diesel cars.

*Use estimated mpg for comparison. Your mileage and range may differ depending on speed, distance, weather. Actual highway mileage and range lower. Driving range estimates are obtained by multiplying EPA and highway estimates by the fuel tank capacity. Some Oldsmobiles are equipped with engines produced by other GM divisions, subsidiaries or affiliated companies worldwide. See your dealer for details.

flies and butterflies have been observed to reach Pacific islands during migratory flights.

The importance of size as related to dispersal capability is also shown by Hawaiian land mollusks. These invertebrates cannot float in air, yet few islands are free of them. According to malacologist Joseph Vagvolgyi, the Hawaiian land snail fauna is composed of groups that stem from ancestors with very small body and shell size. He has amassed from the literature an impressive number of instances in which, under natural conditions, small mollusks have been seen attached to bird feathers. The snails' quick-drying mucilage secretions make adherence to bird feathers easy. Moreover, as any gardener knows, snails can live for prolonged periods without water, sealed in their shells behind dried slime. The garden snail, however, is too large to have reached Hawaii: successful adherence to birds is apparently linked to small size.

Of all groups of animals, birds would appear to have the least difficulty establishing on islands. Why then have Hawaiian land birds (excluding wading birds) successfully colonized on so few occasions? The answer, in part, is simply that land birds do not travel very far, even in feeding flights. Their homing and territorial instincts are strong, and they return to base areas quickly and unerringly. Blown away from the patch of forest where they live, land birds could become disoriented; unable to locate the patch again, they might not survive.

No land bird migration routes cross the Hawaiian Islands, and land birds will reach the islands by natural means only if they are caught in a weather system that happens to take them there. Because land birds are not very good at staying aloft for long times, fast-weather fronts such as typhoons probably provided the Hawaiian Islands with land bird arrivals. Most land birds buffeted about by such storms would not arrive in good condition, however, so the chances of successful colonization are very few: birds are much more fragile than seeds. A gravid (egg-carrying) female in good condition, capable of making a living in the spot to which she is blown, is what is needed. That may happen only once in a million years, but biologists and geologists do not find such periods of time preposterous. (The island of Hawaii is about a million years old, Kauai more than five million, and west of Kauai, the lesser Hawaiian Islands, which were once larger islands, are even older.)

With so few successful bird colonizations, the chances of witnessing one happening on Hawaii are nil. A few cases have been seen elsewhere, however. In 1955, ornithologist Austin L. Rand reported that purple gallinules, noted as chance visitors to Tristan da Cunha, a remote island in the South Atlantic, had at last formed breeding colonies there. In the late nineteenth century, the African cattle egret, formerly native only to Africa, crossed the South Atlantic by natural means and successfully colonized first South and then North America.

The various kinds of evidence cited for chance dispersal to the Hawaiian Islands inevitably involve parallel examples, and as such, skeptics may object to them. The establishment of cattle egrets in South America cannot prove, despite some similarities, the establishment of a bird group in Hawaii. The ability of seeds to withstand soaking in salt water is not proof that their relatives once successfully colonized the Hawaiian Islands by washing ashore after somehow drifting at sea. Circumstantial evidence may be the best we ever have in reconstructing past Hawaiian dispersal events, but such evidence may never persuade those who believe that a few random events of chance colonization cannot explain an entire flora and fauna.

The only alternative to chance dispersal as a means for populating the Hawaiian Islands with plants and animals would be the existence at some period of a land bridge between continents and lands that now are islands. But has such continuity ever existed? To the west of the Hawaiian Islands, there are islands older than the main chain and now eroded down to small rocks, such as Necker Island and Gardner Pinnacles. Beyond them, there are islands worn down to sea level—the atolls of Midway and Kure, for example. Considerably farther west is another island in this series, Wake. Between Wake Island and Siberia are even more ancient, even more sunken islands: the Emperor Seamounts, very likely the earliest products of the island building that is still alive today in the Hawaiian volcanoes. There is no evidence that the Emperor Seamounts ever formed a solid land bridge with Asia or that the younger islands were ever linked to the Hawaiian chain. Probably, great spans of ocean always existed between the islands in these archipelagoes. Furthermore, the roster of plants and animals on the Hawaiian Islands does not suggest any preservation of ancient groups. The genera and families of plants and animals in the Hawaiian Islands are not very different from those on any recent Pacific volcanic islands, such as the Bonin Islands south of Japan.

More important, the areas that provided the ancestors of Hawaiian life are not close to the islands, and they do not form the sort of coherent pattern that a former geologic connection would produce. This is particularly true with the plants. The sources for the plant colonists ancestral to the Hawaiian flora are numerous and diverse. The largest proportion of Hawaiian plants are related to plants in tropical Asia and Indonesia, but there is also a definite American connection: more than 20 percent of the ancestral plant colonists have clear relationships with plants of North and South America.

Somewhat like replications in laboratory experiments, islands other than the Hawaiian chain have also contributed to the web of evidence for chance dispersal. They, too, have received plants and animals good at dispersal, and these colonizers often belong to plant and animal groups similar to those that have colonized Hawaii. Nevertheless, the evidence we have is tantalizingly incomplete. Perhaps the very nature of the record of establishment after long-distance dispersal, like that of the fossil record, makes incompleteness inevitable. All reconstructions of the past are constrained by the scarcity of evidence, and our picture of how life arrived in Hawaii is likely to remain elusive—and immensely intriguing to biologists. □

The many moods of Hawaii await you at Hyatt.

Tropical beaches, exotic flowers, dazzling days in the sun. It's all waiting for you at three unique resorts, where a Hyatt Hostess fills your stay with Hawaiian hospitality. Enjoy lush, garden surroundings at Maui. Rejuvenate at Waikiki. And for the ultimate getaway, Hyatt Kuilima Resort is a paradise. Come, discover Hawaii with a touch of Hyatt.

For reservations, call your travel planner or 800 228 9000.

HYATT KUILIMA RESORT
on Oahu's North Shore

HYATT REGENCY MAUI
on Kaanapali Beach

HYATT REGENCY WAIKIKI
at Hemmeter Center

a touch of Hyatt

HYATT HOTELS HAWAII

©1982 Hyatt Corp.

Transported Landscapes

Long before Captain Cook discovered Hawaii, the islands and their flora and fauna had been transformed by Polynesian settlers

by Patrick V. Kirch

During the ten million years or more that the main Hawaiian Islands have existed as an archipelago, they have received a stream of colonists, ranging from passively dispersed seed plants and insects to migratory or wayward birds. From such progenitors evolved distinctive flora and fauna of marvelous and often bizarre forms. Because they evolved in isolation, however, these endemic life forms were extremely vulnerable to outside competitors. No more than about 1,600 years ago, some new colonists—Polynesians—arrived on the scene, culminating the greatest human dispersal of all time, the "conquest" of the Pacific by Oceanic peoples. This conquest went far beyond the discovery of the most isolated islands on earth. The story of Polynesia is one of interaction between people and island ecosystems that had for millions of years evolved in the absence of humans and other large terrestrial animals. While the Polynesians had to adapt to the conditions and challenges posed by island life, this was no passive adaptation. Rather, the Polynesians modified and at times drastically altered their island homes.

The impact of the prehistoric Polynesians on Hawaii has not always been appreciated by biologists and anthropologists. Biologists have often assumed that the major decline and extinction of native species occurred only in the past two centuries, following the advent of Europeans with their introduced weeds, insects, cattle, goats, sheep, and so on. Similarly, many anthropologists—intrigued by the conservation techniques sometimes practiced by Oceanic peoples, including the Hawaiians—assumed that there was a sort of harmonious relationship between the Polynesians and their environment.

Evidence that the early Polynesian settlers in Hawaii drastically altered their environment has slowly been accumulating for decades, but it was a serendipitous discovery in 1976 that startled archeologists and biologists into realizing that their data formed a coherent picture of prehistoric human impact. Bishop Museum archeologist Akihiko Sinoto found large quantities of well-preserved bird bones in several limestone sinkholes situated in an ancient elevated reef at Barbers Point, Oahu. Sinoto had been testing these sinks for evidence of human use, either for habitation or for agriculture. The surprise came when these semifossil bones were submitted to paleobiologists Storrs Olson and Helen James of the Smithsonian Institution, who determined that several unknown and bizarre species of birds were represented by this material, including a large, flightless goose. The Barbers Point material was unusual not only for the extent and diversity of the extinct species present but also because it showed that many of these birds had survived well into the period of human occupation of the islands. Had the Polynesians been in some way responsible for the reduction of this bird fauna?

In an effort to reconstruct the environmental context of these birds and any role that humans may have played in altering this environment, Carl Christensen, a Bishop Museum malacologist, and I began a study of the abundant fossil shells of terrestrial snails that had been observed in the same limestone sinks that contained the bird bones. Land snails are known to be good indicators of local environmental conditions, and in a manner analogous to pollen analysis, the relative frequencies of species through a sequence of sedimentary deposits may be used as evidence of environmental changes.

In analyzing our column samples from the Barbers Point sinkholes, we made several significant findings. First, in the upper levels of the sinks, where the extinct bird bones were concentrated, several endemic species of land snails declined greatly in abundance, while certain other species increased. Significantly, the species that became more abundant were those that continue to demonstrate that they are good competitors, surviving in the Hawaiian lowlands even in the face of a variety of more recently introduced species. Far more interesting, however, was the appearance in these same stratigraphic levels of *Lamellaxis gracilis*, a particular species of land snail known to have been transported by humans with soil and plants over much of the tropical world. Shells of *Lamellaxis* had been recovered from prehistoric archeological sites in the South Pacific dating to as early as 1200 B.C., and we suspected that the early Polynesians had also brought this species to Hawaii as a stowaway on plant stocks. We also found other clues—the bones of *Rattus exulans*, a small rat associated with Polynesian settlements, and of a gecko and a skink, two species frequently dispersed by humans.

A consistent picture thus emerged from the Barbers Point investigation: at the time that the now-extinct birds were dying and their bones were being deposited in large numbers, the local environment was undergoing a radical change. Not only did the land snails indicate changing vegetation conditions, but the *Lamellaxis*, rats, geckos, and skinks indicated that humans were present in the area and suggested that their actions were in some way responsible for these changes. The extinction of the birds was probably due to the alteration of their habitats rather than to direct predation by the Polynesians. Recent evidence, however, does suggest that now-extinct birds were also hunted and eaten by the early Hawaiians. During the past two to three years, additional major archeological projects—mostly under the aegis of the Bishop Museum—have provided more information concerning the past environment of various areas of Hawaii and the role of humans in changing the landscape and its life forms.

The Polynesian alteration of the Hawaiian ecosystem began with the initial human colonization of the archipelago early in the first millennium A.D. In their original state, the Oceanic islands—including Hawaii—offered little in the way of terrestrial food resources for human settlers. Certainly, rich shellfish beds, abundant fishes and turtles, and large populations of nesting sea birds would have provided a good supply of protein for the first colonists, but edible food plants, particularly farinaceous staples, were lacking (an exception was the indigenous tree fern, whose starchy pith was utilized by the Polynesians in times of famine). To establish themselves on the islands, the Polynesians transported with them a range of crop plants, domesticated species primar-

How dare The Glenlivet be so expensive?

How dare we place such a premium on our 12-year-old Scotch? The same reason vintage wines and fine cognacs are so expensive. Superior taste. Just one sip and you'll know that The Glenlivet has a taste that's decidedly superior.

The Glenlivet is Scotland's first and finest single malt Scotch. Nothing but 100% Highland malt whisky, distilled from natural spring water and fine malt barley, aged in oaken casks, just as it always has been.

Only our time-honored methods can truly achieve The Glenlivet's unequaled taste. A taste that sets it apart. Its smoothness, body and bouquet are qualities found only in this unique Scotch.

Of course, you may elect to purchase a good Scotch that's less expensive. But for a truly superior taste, you have to pay the greater price.

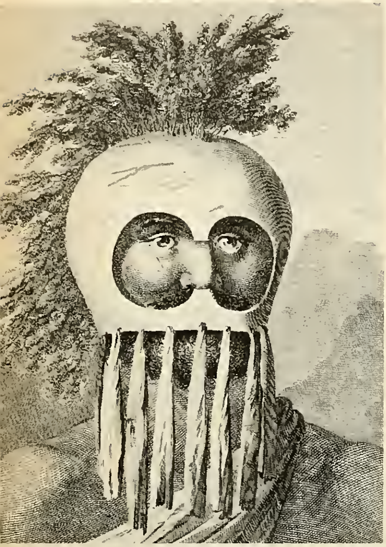
The Glenlivet

12-year-old unblended Scotch.
About $20 the bottle.

AGED 12 YEARS
BOTTLED IN SCOTLAND
The GLENLIVET
12 YEARS OLD
Unblended all malt Scotch Whisky
Distilled in Scotland by GEORGE & J. G. SMITH
THE GLENLIVET DISTILLERY · SCOTLAND
U.S. IMPORTERS THE GLENLIVET DISTILLING COMPANY NEW YORK, N.Y.
750 ML · 86 PROOF
12 YEARS OLD THE GLENLIVET SCOTCH WHISKY

© 1982 SEAGRAM DISTILLERS CO.

On Captain Cook's third voyage of discovery, portraits of native Hawaiians were drawn by John Webber and later published as engravings. The man, below, wears a mask made from a bottle gourd, one of the plants that the Polynesians brought with them when they settled the islands.
AMNH

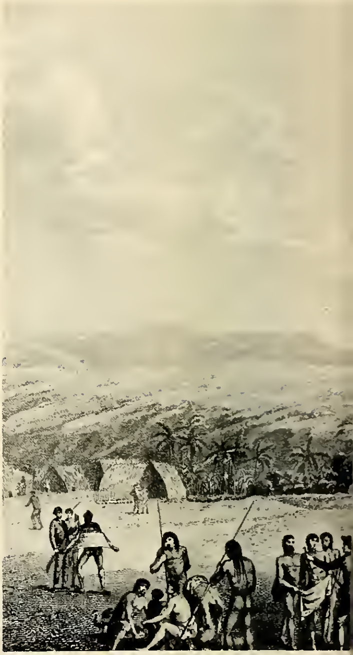


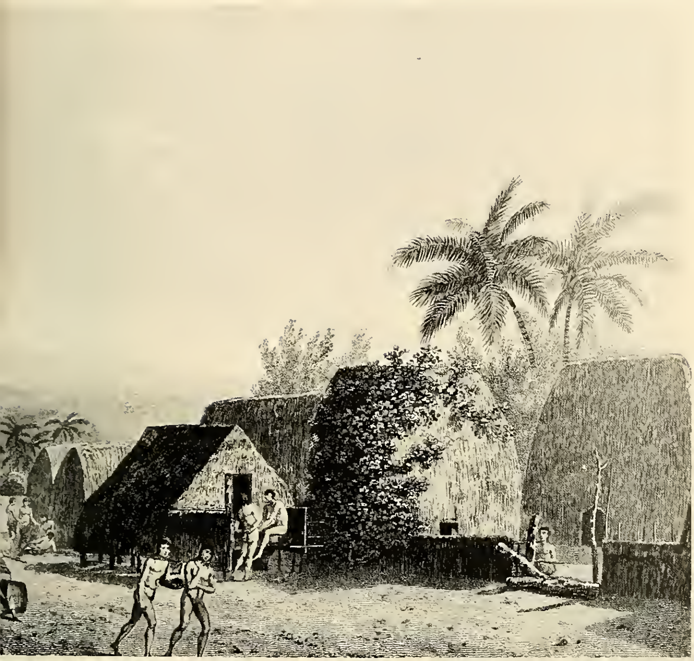
ily of Southeast Asian origin, such as taro, yams, bananas, and breadfruit. Breeding populations of the domestic pig, dog, and jungle fowl were brought along as well, to provide additional food sources in the new landfall. The introduction of these crop plants and animals (at least sixteen species in all), and the clearance of native forest to accommodate gardens and orchards, marked the beginnings of what, over several centuries, became a radical alteration of the Hawaiian environment.

In their double-hulled voyaging canoes, the Polynesians carried far more than a set of crop plants and domestic animals. We have already seen that land snails (not only *Lamellaxis*, but probably also *Lamellidea oblonga* and *Gastrocopta pediculus*) and a small rat, geckos, and skinks were introduced to Hawaii. These species were presumably all inadvertent stowaways on the voyaging canoes, and once released in their new island environment, they must have undergone rapid population expansion—particularly since the native fauna were unaccustomed to serious competition. We know also, from the records of botanist David Nelson, who accompanied Capt. James Cook on his third voyage of 1778 (the European "discovery" of Hawaii), that well established in the lowlands were a number of tropical weeds that also must have been dispersed by the Polynesians. These weeds included water purselane, which frequents wet habitats such as irrigated pond fields of taro, and crabgrass, which abounds around pigpens. Like snails, rats, and lizards, these weeds are powerful competitors; they must have immediately begun to replace endemic lowland plants wherever the Polynesians settled.

Both the purposeful and the inadvertent introductions to Hawaii of a range of competitive species by the Polynesians provide a classic example of what the botanist Edgar Anderson called "man's transported landscapes." Not only did the Polynesians surround themselves with an imported flora and fauna; they also undertook to actively modify and manipulate their insular environment according to cultural concepts that they had inherited from their ancestors in the South Pacific and, ultimately, Southeast Asia. Having arrived in this remote Pacific archipelago, the Polynesians did not simply adapt passively to its constraints and limitations, for like all human groups, they had their own ideas and values concerning how the world was to be ordered. As anthropologist Marshall Sahlins put it, the "action of nature is mediated by a conceptual scheme," a scheme that for the Polynesians included such concepts as the efficacy of fire in clearing forest for garden land, the feasibility of diverting streams to feed irrigated pond fields, and the suitability of broad coastal mudflats for the construction of large fishponds. In short, the Polynesians saw their island world as a plastic landscape to be molded to suit the needs and purposes of a growing human community.

As with other species that had preceded them to these shores, the Polynesians who colonized Hawaii underwent a rapid population explosion, growing from probably fewer than 100 persons at the time of first settlement to somewhere between 200,000 and 300,000 at the time of Captain Cook's first contact in 1778. During the first few centuries after settlement, the population remained small and the impact of human activities on the native environment was probably slight. But, as the population increased at a geometric rate, and the need for new agricultural land and the exploitation of wild food resources increased, this impact became correspondingly greater. By 1200 the population had multiplied to a point where the more marginal leeward coasts of the main islands were being permanently settled, and by 1400 large tracts of leeward parkland and forest were being cleared to make way for extensive field systems of cultivated sweet potato and taro. At the same time, valley bottoms were being converted to irrigated complexes, and the broad reef flats of Kauai, Oahu, and Molokai were modified by the construction of several hundred stone-walled fishponds for the husbanding of mullet fish. By 1600, probably 80 percent of all of the lands in Hawaii below about 1,500 feet in





An inland view of Waimea, Kauai, by shipboard artist John Webber shows the dispersed settlement pattern that characterized the Hawaiian landscape at the time of Captain Cook's arrival in 1778. The early Hawaiians made extensive use of fire to clear forest for agriculture and to maintain grasslands.
AMNH

elevation had been extensively altered by the human inhabitants. Today, only a few small areas of remnant dry or moderately moist forest hint at the former diversity of life in the lowland areas. Clearing of these habitats to make way for agricultural fields resulted in the extinction of untold numbers of species of plants, arthropods, land snails, and birds.

Like tropical agriculturists everywhere, the Polynesians made extensive use of one great tool, fire. Polynesian agriculture was essentially a form of shifting cultivation: tracts of forest or bush were cleared and burned to create garden plots; after several years of cultivation, these would be abandoned to secondary vegetation, and new plots would be cleared. As the population of the islands increased, however, many areas were gradually converted to more or less permanent cultivation, either dry-field systems on the leeward slopes or irrigated pond fields in valley bottoms.

Fire was also used to maintain tracts of grasslands created through removal of forest. Archibald Menzies, who was with the explorer Capt. George Vancouver in 1792, observed a great fire that burned off thousands of acres of dry tanglehead (*pili*) grass. Menzies reported that the Hawaiians purposely set such fires every year or so, as "the next crop of grass grew up clear and free of stumps, and was therefore better adapted for thatching their houses."

The clearance of large tracts of leeward slope and valleys, and the replacement of native forest with cultivations and secondary-growth shrubs and grasses, had an impact not only on the life forms of the islands but also on the physical landscape itself. Removal of native vegetation had the effect of exposing hillsides and slopes to erosion, and it now appears that the rate of erosion in some areas increased significantly after the human colonization of Hawaii. On Molokai Island, extensive alluvial deposits at the base of the Halawa Valley have been dated to the thirteenth century and are believed to reflect erosion caused by forest clearance on the valley sides. Charcoal in the erosional deposits indicates that fire was used in the forest clearance. The deposits also contain—in the lower levels—thousands of shells of endemic land snails that testify to the diversity of the original forest habitat prior to clearance.

The increased erosion and deposition of alluvial sediments in valley bottoms certainly had consequences for the Polynesians themselves. In the upper Makaha Valley on Oahu, forest clearance on steep ridges caused a major mudslide that buried the fields and ditches of a complex of irrigated taro fields under thousands of cubic yards of sediment. Archeological excavations in this field complex revealed this major geomorphic event and further showed that the valley's occupants had laboriously dug themselves out of the mud and rebuilt the irrigation complex. Probably not all erosion had such deleterious effects. In some areas, such as Kahana Valley on Oahu, increased deposition of sediments may have helped create alluvial flood plains more suited to the construction of irrigated fields than the original valley bottoms.

In the past decade, archeological investigation in Hawaii has disproved the old assumption that the Polynesians did not have a major impact on their island environment. We now have evidence that at the time of initial settlement by Polynesians from the South Pacific, the Hawaiian Islands supported a much more diverse flora and fauna than were recorded by the early European naturalists some fourteen centuries later. The impact of the Polynesians was, naturally, strongest in the lowlands, where they transformed vast areas of native forest into a cultural landscape of agricultural fields, grasslands, and habitations. While we are still just beginning to understand the scale of this human modification of a remote oceanic archipelago, the Hawaiian case serves to remind us once again that the study of nature is in many ways inseparable from the study of culture. ☐

Radiating Silverswords

Despite the striking variation in a group of native Hawaiian plants, all the evidence suggests a common ancestry

Visitors to the island of Maui often make a special trip to Haleakala National Park to see the Haleakala silversword (*Argyroxiphium macrocephalum*), one of Hawaii's most photogenic native plants. Few admirers of the handsome silversword realize that the group of plants to which it belongs—known as the silversword alliance—is perhaps the foremost example of adaptive radiation in the plant kingdom. Strong evidence indicates that a single colonizing species has diversified, in less than six million years, into a remarkable array of species occupying nearly every type of habitat in the Hawaiian Islands.

Approximately twenty-eight species in three genera make up the alliance, which belongs to the sunflower family (Compositae). There are about five species in the genus *Argyroxiphium* (which includes the silverswords as well as plants known as greenswords), about twenty-one species of *Dubautia*, and two of *Wilkesia*. The species range in form from small, mat-forming shrubs and ground-hugging rosette plants to climbing vines and even sizable trees. Some species live in moist environments, including what may be the wettest spot on earth, the summit of Kauai, which receives some 500 inches of rain a year. Others are physiologically adapted to cope with such extremely arid environments as the exposed slopes of volcanic cinder.

Leaf sizes and shapes, too, vary tremendously among members of the alliance. *Dubautia* species living in arid and bright habitats tend to have very small leaves compared with those of species inhabiting shady, wet areas. The leaves of silverswords—rosette plants of high elevations—have a dense silvery coating of hairs, presumably to protect the underlying tissue from intense solar radiation and to aid in moisture conservation. Greenswords, found at lower elevations in rain forests and bogs, lack protective hairs.

Several lines of study have led scientists to the conclusion that the plants of the silversword alliance all evolved from a single colonizer. Careful observations of the structures and life patterns of the plants gave initial impetus to the theory. More recently, studies of hybridization among the various species and of chromosomal patterns have provided strong support.

Since the oldest of the major Hawaiian Islands—Kauai—dates to less than six million years ago, the descendants of any presumed colonizer should still be related closely enough to produce hybrids. This indeed appears to be the case. Scientists have observed the spontaneous formation in nature of hybrids between different species of the same genus as well as between species of different genera. They have also experimentally produced hybrids, in some cases between species from extremely different habitats at opposite ends of the island chain—for example, from moist forests on Kauai and dry lava fields on

Gerald D. Carr

Species in the genus Dubautia*—one of three genera in the silversword alliance—are found in virtually every type of habitat in the Hawaiian Islands and range from small, low shrubs to sizable trees. In the wet forests of Maui, for example,* D. reticulata *can grow to be about eighteen inches in diameter and up to twenty-five feet tall.*

The silversword Argyroxiphium macrocephalum *grows on the dry alpine slopes of Maui's Haleakala Crater, where it is exposed to high levels of solar radiation and low humidities. The plant's low-lying rosette shape and the silvery hairs on its long leaves protect it from the intense sunlight and help it conserve moisture. This silversword grows for several years before producing a single, spectacular flowering stalk. After the fruits mature, the entire plant dies.*

Ed Cooper

Growing alongside rosette-shaped silverswords on the dry leeward slopes of Haleakala Crater is Dubautia menziesii, *a medium-sized, diffusely branched shrub with small leaves. Despite the marked differences in the physical forms of these two species, both have leaves with highly modified elastic properties that enable them to withstand severe water stress. Recent evidence suggests that the common ancestor of these plants lacked these traits. Apparently, separate evolutionary pathways have given rise to two species capable of occupying the same harsh environment.*

Raymond A. Mendez

Hawaii. Apparently any two members of the entire alliance can interbreed—and all the hybrids are fertile to some degree, which indicates a close relationship.

Other studies have focused on chromosomal differences and similarities among the plants, which can shed light on their evolutionary relationships. The somatic, or nonreproductive, cells of all *Argyroxiphium*, all *Wilkesia*, and twelve *Dubautia* species have twenty-eight chromosomes, but the somatic cells of nine species of *Dubautia*—all of which occur on the geologically younger islands—have only twenty-six chromosomes. Together with other evidence, the cytogenetic findings point to *D. scabra*, a twenty-eight-chromosome species also found on the younger islands, as the possible ancestor of the twenty-six-chromosome group. Chromosomal evidence also indicates that the silverswords and greenswords are closely related to certain of the *Dubautia* species.

As the work with chromosomes progresses, more information on the evolutionary relationships among these plants will become available. Meanwhile, other studies continue to shed light on the ways different members of the silversword alliance have adapted physiologically to such a wide range of habitats. Because fertile hybrids can in most cases be grown and genetically manipulated, the genetic basis of these adaptations can be readily examined as well. Hence, this group of related, highly diversified plants provides a splendid opportunity for enhancing our understanding of evolution.

Text and captions based on research by Gerald D. Carr of the University of Hawaii, Robert H. Robichaux of the University of California at Berkeley, and Donald W. Kyhos of the University of California at Davis.

One species found on several of the younger Hawaiian Islands is Dubautia scabra. *Chromosomal evidence suggests that many of the* Dubautia *species on the geologically younger islands may have evolved from* D. scabra *or from another, very similar species. The example shown here, whose flowers are dead but still erect, is growing on a recent lava flow on Hawaii. One of* D. scabra*'s presumed descendants,* D. ciliolata, *grows at the same site on patches of an older, drier type of lava. The evolution of* D. ciliolata *involved the development of specialized physiological traits that enabled it to exploit a far drier environment than that inhabited by its recent ancestor.*

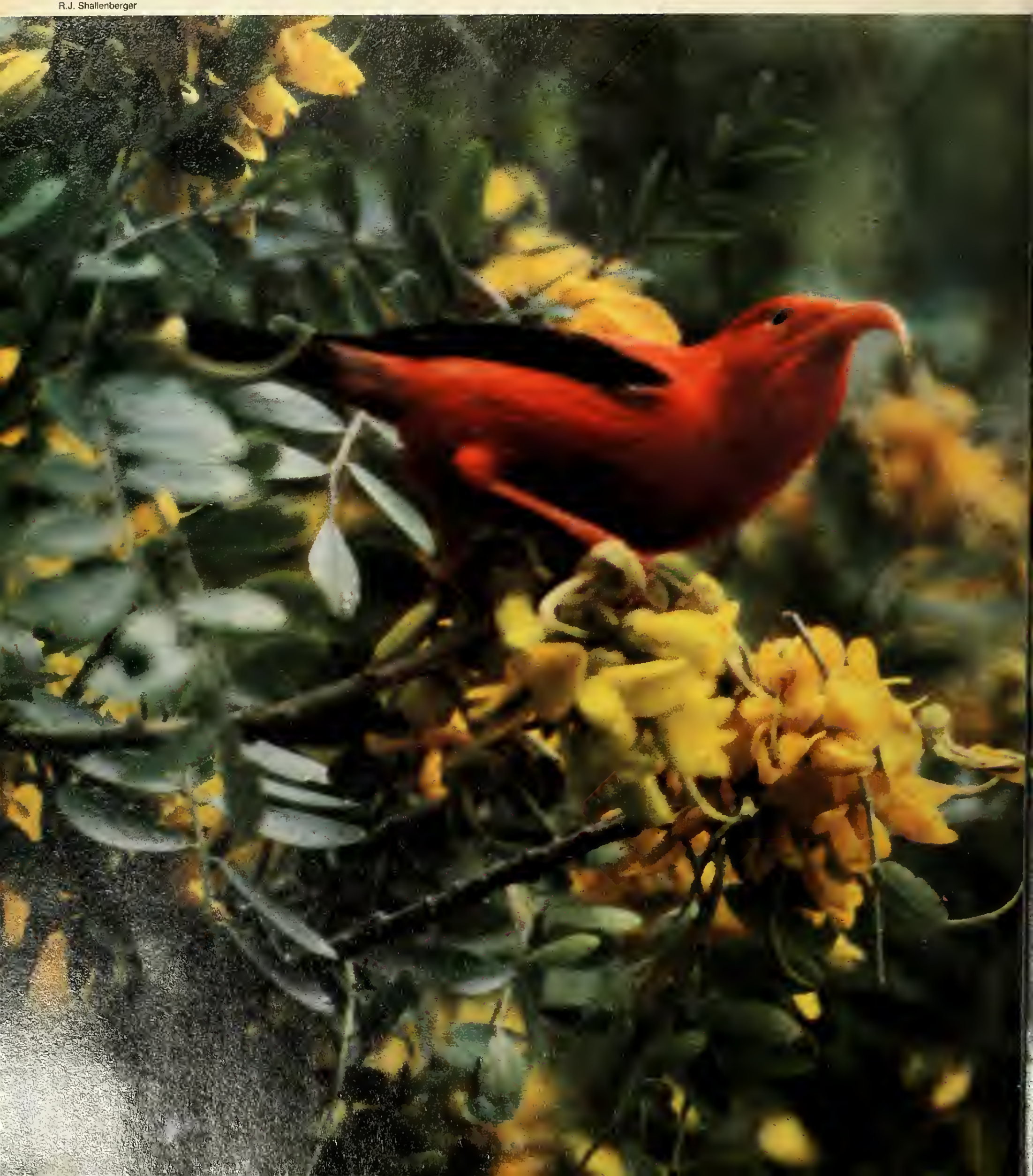
Raymond A. Mendez

On the windward slopes of Haleakala Crater, rainfall exceeds 300 inches per year and the vegetation is lush. Here, too, members of the silversword alliance occur. These species, growing under such favorable moisture conditions, lack the specialized physiological adaptations found in relatives that live in dry habitats. They also tend to differ in outward appearance, generally being taller and having larger leaves.

Gerald D. Carr

A large, curved bill gives the iiwi, a nectar-eating member of the honeycreeper tribe, a top-heavy look. The long beak apparently evolved for feeding in tubular flowers, which may have been more abundant in Hawaii's forests in an earlier era.

R.J. Shallenberger



Birds of the Forest

The remarkable diversity of Hawaii's native forest birds has been severely reduced by deforestation, diseases, predators, and competition from exotic birds

by C. John Ralph

Hawaii's native forest birds provide extraordinary examples of evolutionary adaptation. The Hawaiian honeycreepers, a tribe of finches that probably share a single finch ancestor, have achieved a degree of variation that makes the much vaunted diversification of Darwin's Galápagos finches look downright conservative. The subfamily of Galápagos finches contains about twelve species or subspecies. By comparison, some thirty-seven species or subspecies of Hawaiian honeycreepers existed at the time of Captain Cook's arrival on the islands in 1778, and many more are known to have existed prior to that. The assemblage of honeycreepers includes many standard finches as well as species that look like warblers, vireos, tanagers, blackbirds, parrots, honeyeaters, thrushes, and even woodpeckers.

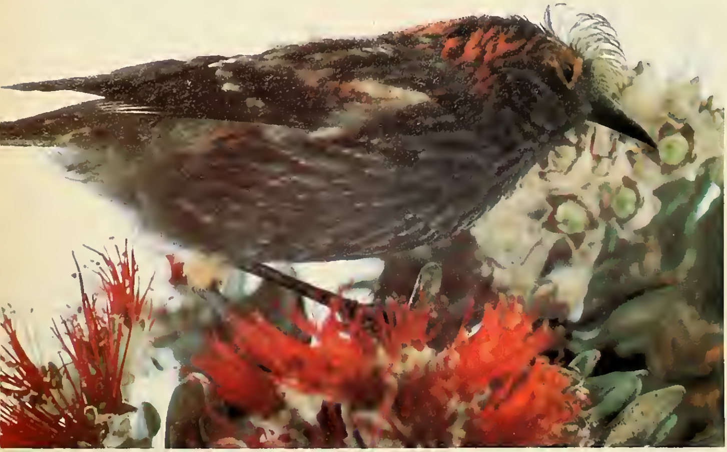
One member of the honeycreeper tribe, the bright red apapane, is easily the commonest of the native birds and occurs in some of the densest populations of any bird in the world. It is a specialist, feeding mainly on nectar in the flowers of the ohia, the dominant tree in native forests. In search of ohia nectar, many apapanes apparently commute from their territories at least once, and possibly several times a day, flying up to ten or twenty miles to reach locally abundant blooms of the ohia.

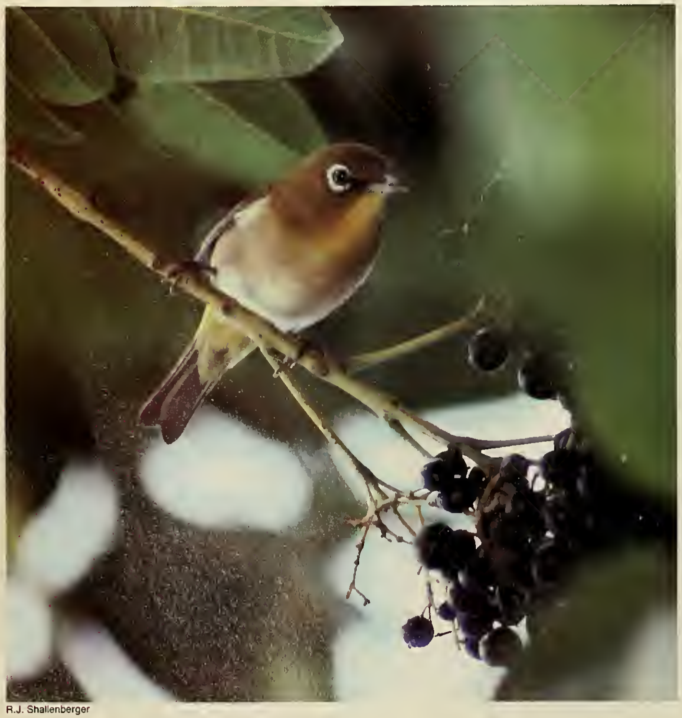
At times, according to season and elevation, the normally green foliage of the ohia becomes a riot of scarlet flowers over hundreds of acres. In response to such a superabundance of food, tens of thousands of apapanes pour into the blossoming area. To accomplish these flights, apapanes normally carry body fat at levels usually seen only in birds that undertake migrations of several hundred miles. Unusually high body fat may also help tide them over rainy periods when nectar is scarce. The apapane has specialized upon a single—but extremely abundant—flower, allowing the bird to flourish.

Other specialized birds have not been so lucky. Perhaps the most unusual looking honeycreeper of the upper-elevation forests is the akiapolaau. The upper part of its bizarre bill is long and decurved, useful for probing in bark, but the lower part is stout and woodpeckerlike. It forages by

With its odd plumage, the crested honeycreeper, top, stands out even among the diverse birds of Hawaii. Surviving only on Maui, it feeds mainly on the flowers of the predominant ohia tree. The plume of feathers on its crown is often sprinkled with ohia pollen and may aid the tree's pollination. In part because of its catholic tastes, the Japanese white-eye, bottom, may be the most successful introduced bird in Hawaii. It thrives in disturbed forests, where it competes with native birds for food. The white-eye is less abundant in undisturbed forests, suggesting that where natural forests are kept intact, the native birds may be able to hold their own against this foreign interloper.

Robert J. Western





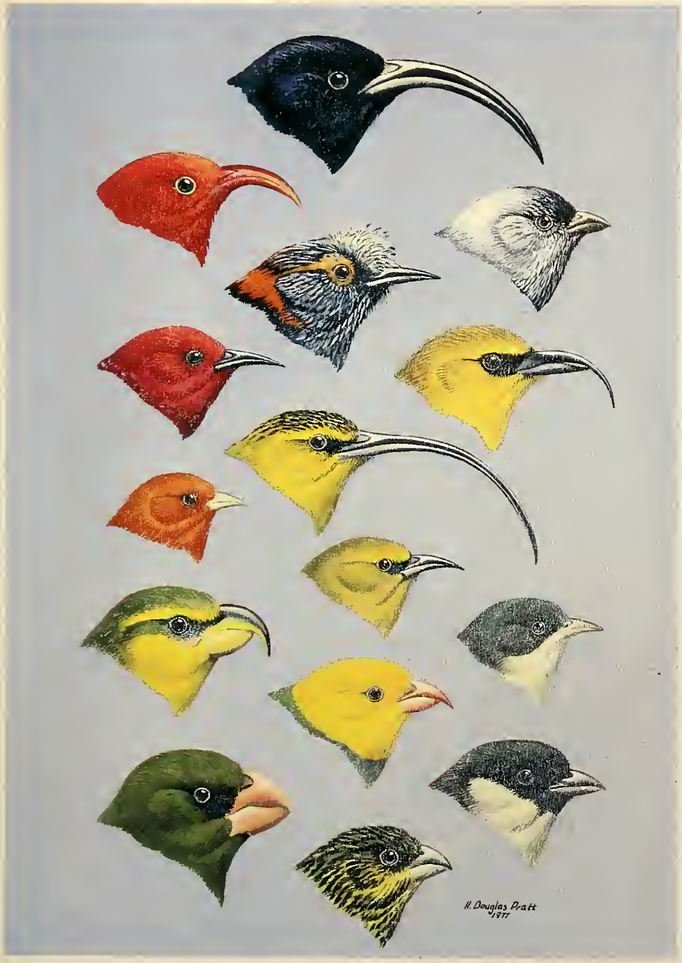
R.J. Shallenberger

throwing its upper bill back and pounding furiously with its lower bill, seeking out insect larvae under the bark of the koa, a large acacia tree. I have found that the akiapolaau prefers koa with large, decaying limbs—generally the larger trees, which are now falling to the chain saws of the timber companies. If natural regeneration were allowed to occur, koa logging would probably not be a severe threat to the akiapolaau. But cattle grazing is preventing most reproduction of koa trees, and the akiapolaau has an uncertain future at best.

Another endangered species is the palila, a finch-billed honeycreeper. Restricted to the open savanna forests on the upper slopes of Mauna Kea at elevations of about 7,000 to 9,000 feet, the palila concentrates its attention on the seeds of the mamane tree. Until quite recently, this tree was subjected to severe grazing by feral sheep, preventing regeneration of young plants. Lawsuits by conservationists, however, forced the state of Hawaii to undertake programs to greatly reduce the sheep population, allowing mamane trees, and thus the palila, to persist.

There are, of course, as many interesting stories of evolutionary adaptation as there are species, and in Hawaii's forests they are not confined to the honeycreeper group. Unfortunately, a majority of these stories will never be known; the rate of extinction of Hawaii's birds has been the highest in the world. On the island of Oahu alone, there were probably twelve species of land birds when Cook arrived; only six survive today. Moreover, the recent bone findings of Storrs Olson and Helen James show that about another twenty land bird species were present on Oahu before Cook's arrival. A good share of these were probably lost during the Polynesians' tenure. Thus the evidence indicates a total loss of about 80 percent of Oahu's native avifauna since the arrival of humans. There is every reason to believe that this figure is, if anything, an understatement of the losses, and that similar losses have occurred on other islands. The number of extant honeycreeper species alone has declined from twenty-two in the eighteenth century to fourteen today—and eight of the surviv-

Artist H. Douglas Pratt has depicted the spectacular adaptations in the bills of the honeycreeper tribe, the members of which apparently evolved from a common, finchlike ancestor. The bills range from short and stout to long and slender. In one species, the akiapolaau (yellow head on right), a stout lower bill, used like a woodpecker's, is combined with a long upper bill, used for extracting exposed larvae from bark.



ing species are regarded as endangered.

It is unlikely that any single bird species became extinct due to a single cause. One threat, however, stands out above all others: the slow but steady conversion of native forests to pasture. No other factor has affected such a great area.

Diseases such as avian malaria and pox viruses have been implicated as the cause of some extinctions. In the early nineteenth century, the first tropical mosquito was introduced to the islands, which had previously been mosquito-free. Mosquitoes spread quickly through the lowland areas and proved to be deadly vectors of bird diseases. The few native birds persisting in the lowlands today have developed resistance to the diseases. Because of their tropical origins, mosquitoes cannot live in Hawaii's cool, higher elevations. But the upland honeycreepers will be vulnerable to the diseases if a new vector, able to penetrate the higher elevations, arrives on the scene.

Introduced predators, such as rats, mongooses, cats, dogs, and pigs, have all affected bird populations in one way or another. Dogs and pigs are known to eat birds, and a strong circumstantial case can be made that the rats do too; their spread on each island has coincided with the demise of several bird species.

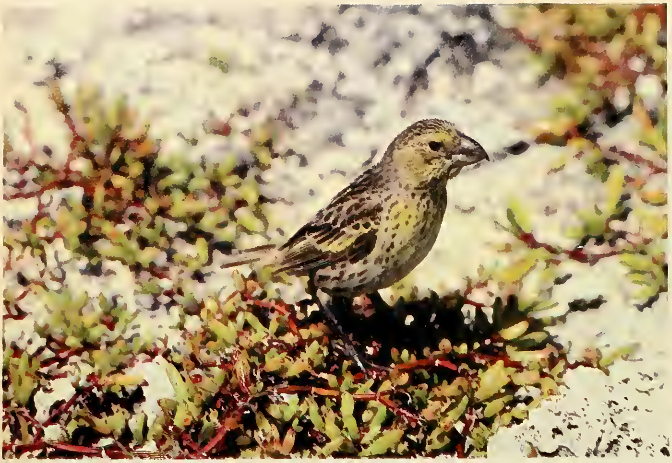
Until recently, the most overlooked cause of decimation of native birds was the role played by the early Polynesian settlers. Although the evidence is again circumstantial, many species probably disappeared during the Polynesians' time because of habitat destruction. By the time of Cook's arrival, the lower slopes were largely barren of native vegetation, having been altered by intensive farming and by fires. Even the upper-elevation "pristine" forests had probably undergone many changes in species composition.

Today, the ohia tree accounts for the vast majority of native forest foliage above about 3,000 feet. Some evidence suggests that the early Polynesians did not originally find such a uniform forest. For instance, we know that the koa tree, the akiapolaau's favorite place to feed, is palatable to various herbivorous mammals introduced by the Polynesians, such as feral pigs and rats. Today, young koa trees are relatively rare and are usually found only where there is some protection from pigs, cattle, and other herbivores. Rats also harm young koas by stripping bark. Over several centuries, pigs and rats may have reduced the reproductive rate of the koa, allowing the ohia to become predominant and thereby affecting the mix of bird species.

Another major and continuing threat to the native birds is the introduction of exotic birds. Possibly the most successful introduced bird is the Japanese white-eye. It is also, therefore, one of the most serious potential competitors of the native birds. This adaptable bird has the bill of an insectivorous warbler but is quite catholic in its tastes. Depending on the time of the year and the area, the white-eye can be

The Laysan finch lives only on Laysan Island, a small atoll at the far western end of the Hawaiian chain. It uses its stout beak to break sea bird eggs, an important food. Scientists believe the Laysan finch is one of the closest surviving relatives of the honeycreeper tribe's ancestral species.

R.J. Shallenberger



seen avidly devouring native berries, a farmer's papaya, or a suburbanite's mango, or sipping the nectar of the ohia tree. It is also extremely abundant and is the commonest bird in many habitats.

The Japanese white-eye is not omnipotent, however. A U.S. Fish and Wildlife Service survey has shown that the white-eye is less abundant in the more intact upper-elevation native forests than at lower elevations. And in the upper forests, it is more abundant in the disturbed than in the undisturbed forests. I have found that in the relatively undisturbed native forests, the white-eye seems to have a fairly hard time competing with native birds. In nearby disturbed forests, the white-eye is exploiting the foraging niches that were once the sole domain of the native birds. If native forests can be kept reasonably intact, then the native birds may well be able to hold their own against this foreign interloper.

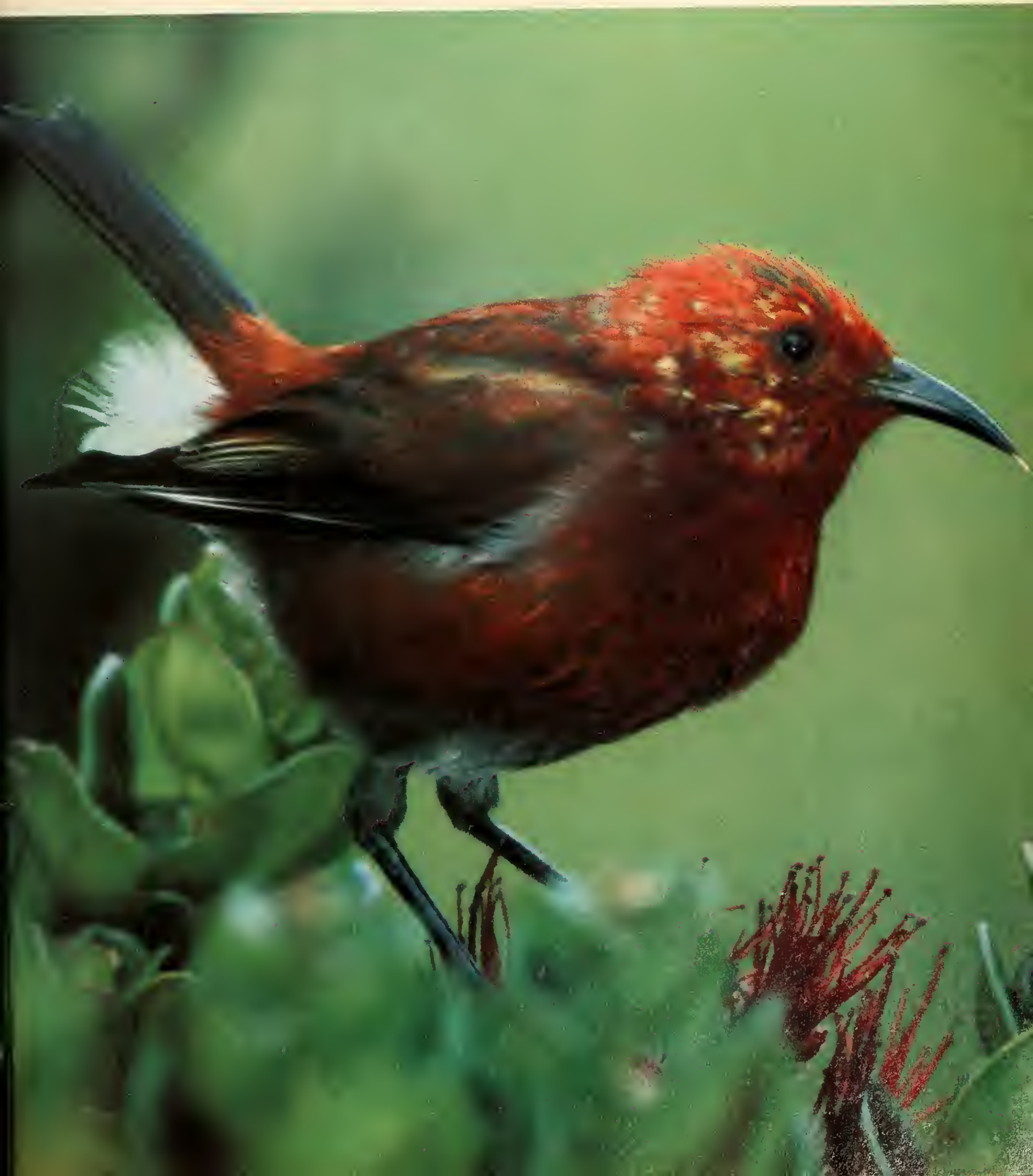
What is the prognosis for the remaining native avifauna? I think it reasonably certain that in the coming decades a temperate-zone mosquito will be introduced into the islands, carrying diseases into the upper elevations and putting a severe strain on already battered bird populations.

Competition from introduced exotic species will always pose a threat, especially to those birds whose evolution took them down the specialist path. Sometimes, misguided people intentionally release alien birds; probably more often, exotics escape accidentally from pet shops, homes, or visiting boats. It seems inevitable that some newly introduced birds will spread and compete further with the native avifauna. Even if the state of Hawaii were more committed to preventing introductions of exotic species than it is, the process would only be slowed.

Perhaps the most likely cause of extinctions in the next few decades will be habitat changes brought about by the logging of koa trees and subsequent grazing of the cutover forests. Badly needed is a commitment by the state and by landowners to allow regeneration of logged forests through the reduction or elimination of cattle grazing, which is slowly converting these areas into pastures suitable only for migrating golden plovers and the introduced skylark. The recent protection efforts of the National Park Service, of some state agencies, and especially of the Nature Conservancy are important beginnings. But habitat preservation must receive far greater support if the remaining native birds of Hawaii's rain forests, the unique products of eons of evolution, are to hold their ground. ☐

The most abundant of the honeycreepers, the apapane feeds almost exclusively on the red flowers of the ohia, the most common tree in the upper-elevation forests. Tens of thousands of these birds may congregate to take advantage of periodic blooms of ohia trees covering hundreds of acres.

Robert J. Western



Introducing a whole new class of cars for 1983

THE CHRYSLER E CLASS

CHRYSLER NEW YORKER

*Whichever comes first Plans are limited warranties. A deductible may be required **Use EPA est mpg for comparison. Actual mileage may vary depending on speed, trip leng

Chrysler's largest front-wheel drive sedans

Chrysler has done it again. For 1983, we've engineered a whole new class of cars—The Chrysler E Class. The E Class Sedan, the New Yorker, available in January, and the Executive Sedan, the only front-wheel drive seven-passenger sedan made in America, available for order this spring.

Even full size cars don't combine the Chrysler E Class sedan's six-passenger room, high gas mileage, advanced front-wheel drive, and electronic luxury.

The Chrysler E Class sedan is the roomiest, front-wheel drive, high gas mileage six-passenger sedan in America. And just as importantly, the E Class sedan is a car that is pure driving luxury. You will experience a road hugging ride. A ride that i quiet and smooth. Yet the E sedan offers even more than all this It offers electronic luxury.

Chrysler introduces a whole new generation of electronics.

The Chrysler E Class has an Electronic Voice Alert t monitor 11 vital functions and audibly helps keep you safe an secure. An Electronic Engine Computer helps you get better fu economy. And you can have an Electronic Trip Computer th displays your trip fuel efficiency, calculates your car's range with remaining fuel, and more.

The E Class has standard: automatic transmission, rack-

CHRYSLER EXECUTIVE SEDAN
Available for order this spring

CHRYSLER E CLASS SEDAN

and weather. Hwy mpg probably lower. †Base sticker price excludes title, taxes and destination charges. Buy or lease at your Chrysler-Plymouth dealer.

with room for 5, 6, even 7 passengers.

and-pinion power steering, power front-disc brakes, plush cloth seats and a power operated counter-balanced deck lid that opens with a touch of a finger. All at an amazing price.

Built with advanced computer technology for lasting quality.

In the E Class sedan, Chrysler has used Computer Aided Design to make engineering new components more efficient so good designs can become even better. Computer Aided Testing assures their reliability for extra years. And Computer Aided Manufacturing helps the final assembly to be uniform and accurate. This technology has resulted in Chrysler's commitment to new levels of quality.

Backed with Chrysler's exclusive 5 year or 50,000 mile protection plan.

The Chrysler E Class sedan's quality is so exceptional each is protected for 5 years or 50,000 miles* on the engine and power train and against outer body rust-through. Your dealer has all the details. The 1983 Chrysler E Class. Impressive Room. High Mileage. Electronic Luxury. Exceptional Protection.

E CLASS SEDAN ONLY

32 EST HWY **24** EPA** EST MPG **$9,341**†

BUCKLE UP FOR SAFETY

WE'VE RE-ENGINEERED THE AMERICAN LUXURY CAR.
THE NEW CHRYSLER CORPORATION. QUALITY ENGINEERED TO BE THE BEST.

Chrysler

In the waters off Tern Island, a Hawaiian monk seal gobbles down a box fish. Among the threats to the seals is an expanding commercial fishery that may deplete their food supply.

R J. Shallenberger

A Seal Slips Away

Hawaiian monk seals are down to a precious few. Unless the reasons are found soon, this marine mammal is doomed

by Robert J. Shallenberger

Twenty-five million years ago, before the main Hawaiian Islands had broken the ocean surface, ancestors of the Hawaiian monk seal were probably found throughout the tropical oceans. In the late Tertiary, about fifteen million years ago, the land bridge that formed between North and South America is believed to have isolated Pacific and Caribbean monk seal populations from one another. From these beginnings, the Hawaiian monk seal—the oldest, most primitive of all living seals—has survived, essentially unchanged, over millennia.

The other two members of the tropical seal genus *Monachus* inhabit the waters of the Caribbean and Mediterranean. For the Caribbean monk seal, the past tense is probably in order: the last authenticated observation of this species was in 1952. The Mediterranean monk seal, which is widely distributed in the Mediterranean and Aegean seas, also has an uncertain future. Although its relationship with humans extends back for more than 5,000 years, in recent years this species has been forced into a small fraction of its former habitats by growing human populations, including tourists and fishermen. The Mediterranean monk seal is critically in need of aggressive measures to protect its remaining habitats, but these fall under the jurisdiction of as many as twenty different countries, many of which are not on the best of terms with each other.

The Hawaiian monk seal, on the other hand, is limited in distribution almost totally to the confines of the Hawaiian archipelago. Today, all of its breeding habitat is found west of the main islands, on the atolls and rocky islands between Nihoa and Kure. This habitat includes only 3,430 acres of emergent land, less than 0.1 percent of the total land area in the state. These, the Northwestern Hawaiian Islands, range from rocky crater remnants towering over 900 feet to expansive shoals with shallow reefs and sandy islets. Among the group are a few islets such as Midway, Kure, and Tern, which have been highly altered during periods of military occupation during this century.

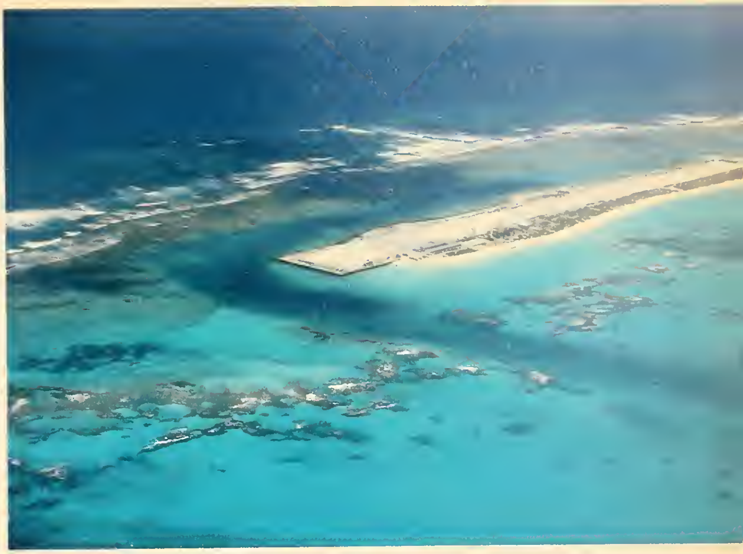
Monk seals seek out sandy beaches where they can haul out to rest, pup, and nurse their young. The basaltic intertidal shelves of Nihoa and Necker islands and exposed reefs at other sites also attract some seals out of the water. Some sandy islets attract seals, including pregnant females, in unusually high densities. These preferred pupping beaches are generally close to shallow, protected reef areas that provide suitable habitat for mothers with young pups.

Although observations of copulation are rare, all recorded matings have occurred in the water. Many males may be involved, but we don't know whether more than one male actually mounts the female. After a gestation period believed to last about eleven months, a single black pup weighing 35 to 45 pounds is born on the beach. Most pupping occurs between February and June, but new pups have been recorded in all months. The 450- to 650-pound mother is highly protective of the pup, which does little but nurse and sleep for its first two weeks. Gradually, mother and pup begin to spend more time in the nearshore waters where swimming skills must be learned quickly. By the time of weaning, at an average age of thirty-five days, pups may have quadrupled their birth weight. The accumulation of fat stores will tide them over after weaning until they can feed successfully on their own. By four months after weaning, pups may spend as much as ten days at a time away from the pupping site, presumably on feeding sorties.

Mothers usually leave the pupping island for a few days or weeks after weaning, striving to replenish the food stores they shared as milk with their growing young. They may or may not pup again the following year. Research data indicate that 50 to 60 percent of the females producing pups in one year will also produce a pup in the following year.

Like other pinnipeds, monk seals undergo an annual molt of their body hair. Unlike most species, however, monk seals shed their hair in large patches or sheets. Monk seals molt over a period of more than eight months of the year, whereas temperate seals generally have a much shorter molting season. Molting in individual monk seals lasts eight to nine days, *Sandy beaches are prime habitat for monk seals. The animals haul out on the beaches to rest, give birth, and nurse their young. Preferred pupping beaches have shallow, protected reef areas offshore.*

R.J. Shallenberger



Environmental impact comes in many shapes and sizes. The landscape of Tern Island has been altered to accommodate a landing strip, but the engineers did leave a bit of space for the seals.

R.J. Shallenberger

during which time the animals are usually found on shore. The black natal pelage of the monk seal pup is replaced by a silver-gray coat at the time of weaning. This, in turn, is not molted for twelve to eighteen months.

Monk seals are conspicuously inactive on land. An occasional brief interaction between a male patrolling the shore and an uninterested female on the beach is just about as exciting as it gets most days in a monk seal colony. The heat of the tropical sun may account, at least in part, for the typically inactive nature of monk seals on the beach. Physiological studies have revealed that they have no adaptations to high solar radiation. By making trips to the water or to the shade of vegetation on the beach crest and by digging into the cooler subsurface sand, the seals make it through the day. Sweat glands appear to be inactive.

Virtually all we know about the Hawaiian monk seal is the result of research during the last twenty-five years. This species was not even described for science until 1905, by which time it had already been driven to near-extinction by sealers seeking skins and oil. Soon after, in 1909, President Roosevelt established by executive order the Hawaiian Islands Reservation, to protect wildlife of the Northwestern Hawaiian Islands from unregulated commercial exploitation. This reservation became the Hawaiian Islands National Wildlife Refuge in 1940, under the administration of the Department of the Interior. Kure was placed under Navy jurisdiction in 1936 and returned to the Territory (later State) of Hawaii in 1952; Midway has been a naval facility since 1903.

Without commercial exploitation, the monk seal population made a striking comeback in the first half of this century. When Dale Rice and Karl Kenyon began their studies of sea birds and seals in the late 1950s, their actual counts of seals on the beaches of the wildlife refuge ranged as high as 1,206, with a mean closer to 1,100. Soon after, however, the Hawaiian monk seal made its second trip on the downhill slope toward extinction. No actual count in the last decade has exceeded 800 animals, with a mean in recent years closer to 550. If an overall decrease of 50 percent is not enough cause for alarm, the pattern of population decline is particularly distressing. The most westerly atolls (Kure, Midway, and Pearl and Hermes Reef) show declines as high as 90 percent. Declines at Lisianski and Laysan islands have been more moderate, while French Frigate Shoals exhibited a sixfold increase until about 1975, when the population appeared to level off. It is tempting to speculate on a west to east migration of seals, yet data on the movements of tagged seals do not support this theory. In fact, less than 5 percent of the more than 1,000 seals tagged and resighted since the late 1950s were observed at sites other than where they were tagged, and these animals moved in both east and west directions.

High mortality in early life may account for the declines in the western atolls. This is particularly true on Kure, where despite continuing annual production of ten or more pups, recruitment of juveniles

Off Pearl and Hermes Reef, below, and in other Leeward Islands, facing page, pups can be seen in the company of their mothers most of the year. Pupping, however, reaches a peak during the period from February to June. Shark predation and disease are considered prime factors in the high mortality suffered by young Hawaiian monk seals.

David Cavagnaro

into the population has been virtually nil. A further contributing factor may be periodic die-offs of animals in all age classes. Such an event, involving more than fifty animals, was documented on Laysan in 1978 and could easily have gone undetected at other sites in previous years. This could explain the marked decrease in abundance of seals of all ages that occurred at Pearl and Hermes Reef and at Lisianski Island.

Without successful recruitment of young into the population and survival of adult females, population recovery is unlikely. The factors responsible for the excessive mortality in the monk seal population are not clearly understood, but they have become the focal point for both serious research and heated political controversy. Impetus for timely answers to the mortality question stems from both the rapid decline in numbers and the growing pressure to expand commercial fishery operations around the Northwestern Hawaiian Islands, an action that in itself could contribute to a further decline in the seal population.

Among the factors that appear to have figured most prominently in the monk seal's decline are human disturbance, shark predation, and disease. The human role is evidenced by the dramatic decreases on populated islands such as Midway. Perhaps even more indicative of the subtle yet real influence of human activity is the tenfold increase in seals hauling out at Tern Island in the three-year period since the Coast Guard's Loran station was decommissioned in July 1979.

The effect of commercial fisheries on the monk seal has been a subject of heated debate, but little is firmly known about the topic. Recent dive studies of monk seals, together with a growing body of information on monk seal feeding habits gained from analysis of scats and regurgitations, suggest that some expanding fisheries, such as of lobster, are likely to compete directly with seals for food. Data on other pinnipeds, including the Mediterranean monk seal, reveal significant fishery-related mortality as well. Hawaiian monk seals are sometimes found entangled in the nets and ropes of fishermen, but the magnitude of the problem is unclear.

Shark predation may cause substantial mortality at some atolls. Disappearance of virtually all pups at Kure after weaning is suggestive of shark attacks. Monk seals of all ages are frequently seen with shark-inflicted scars, and seals are also found in the stomachs of large tiger sharks. Some mortality, particularly among the young, may be attributable to attacks by adult male seals seeking mates. This problem appears most serious at sites where the number of males is two to three times the number of females.

Disease is among the least understood factors affecting monk seal mortality. Recently, considerable speculation and limited research have focused on the possible role of ciguatera. This disease, which can be fatal in humans, is contracted by eating certain reef fish. The dinoflagellate *Gambierdiscus toxicus* has been implicated as the source of ciguatoxin in the reef ecosystem. During an investigation of a monk seal die-off on Laysan in 1978, high levels of ciguatoxin were found in tissues of two seals tested. The symptoms displayed by dying seals were not unlike those characteristic of ciguatera poisoning. Several of the seals examined on Laysan also had heavy gastrointestinal parasitism.

Effecting recovery of this species is no simple task. The wildlife manager is confronted with a curious dilemma. Obviously action must be taken to stop the monk seal's continuing decline and eventual extinction. But what action? In the absence of definitive data, how can we be sure that our research programs or actions to save the seal are not accelerating the decline or harming other species? Additional value judgments must be made in cases where actions to save this species conflict directly with the commercial exploitation of fishery resources.

In 1976, at the recommendation of the Marine Mammal Commission, monk seals were listed as depleted under the Marine Mammal Protection Act and as endangered under the Endangered Species Act. Since that time, cooperating agencies have wielded a two-pronged attack on the problem, involving research to identify factors affecting the seal population and specific management actions to promote recovery. In 1980, a team of scientists was appointed to prepare a plan of action for recovery of the species. Sadly, without major commitments of manpower and funding, this recovery plan will amount to just so much paper and will be of little real significance to the Hawaiian monk seal. ☐

David Cavagnaro

The Flies Fan Out

One or two progenitors have given rise to a dazzling array of almost 1,000 species of drosophilid flies

by Kenneth Y. Kaneshiro and Alan T. Ohta

Hawaii has more than 500 described species of endemic pomace flies, approximately 200 additional species are in our collection at the University of Hawaii but have yet to be described and classified, and more than 200 species are estimated to await discovery. This large complement of species seems to be descended from a single or, at the most, two original colonist species. Pomace flies today occupy habitats as disparate as morning glory flowers near sea level and slime fluxes of *Myoporum* trees growing on the slopes of Mauna Kea at elevations of up to 7,000 feet. They have been found in desertlike environments where the soil is powdery dry, in rain forests with lush tree-fern jungles, and in swampland perpetually shadowed by rain clouds and with vegetation that is burdened with dripping, moss-laden branches.

A team of evolutionary biologists has spent nearly two decades of intensive interdisciplinary research in an effort to understand the mechanisms that have enabled these flies to adapt to the diverse Hawaiian environments. These studies have included the fields of behavior, biochemistry, developmental biology, ecology, external and internal morphology, genetics, physiology, and systematics. We have focused our research on two behavioral traits—oviposition and courtship—that may be important factors governing the rate of evolution as well as the tremendous diversity in the Hawaiian Drosophilidae. For this study we have used an especially striking group of large flies loosely called the picture-wings after the black-and-white wing patterns they display.

An explanation of species evolution on Hawaii must begin with the original colonization events. When a new population is founded on an island, the colonizers may consist of a few individuals or even a single fertilized female. The founders are not select individuals from the ancestral population; flies, for example, are randomly picked up by prevailing winds, high jet streams, and tropical storms, and carried from one island to another. Under such conditions, only a portion of the total gene pool of the ancestral stock is represented by the founders. Thus some of the genetic variability present in the ancestral stock is lost.

The founders, having survived relocation to another region or island, must find a suitable habitat in which to live and breed. During the early stages of colonization, the size of the newly established population is small. The forces of natural selection—competitors and predators—will be subdued, permitting the survival of genetic combinations that were restricted by natural selection in the ancestral population. These conditions allow for new genetic combinations upon which natural selection can later act, enabling differentiation to occur in the colonizers.

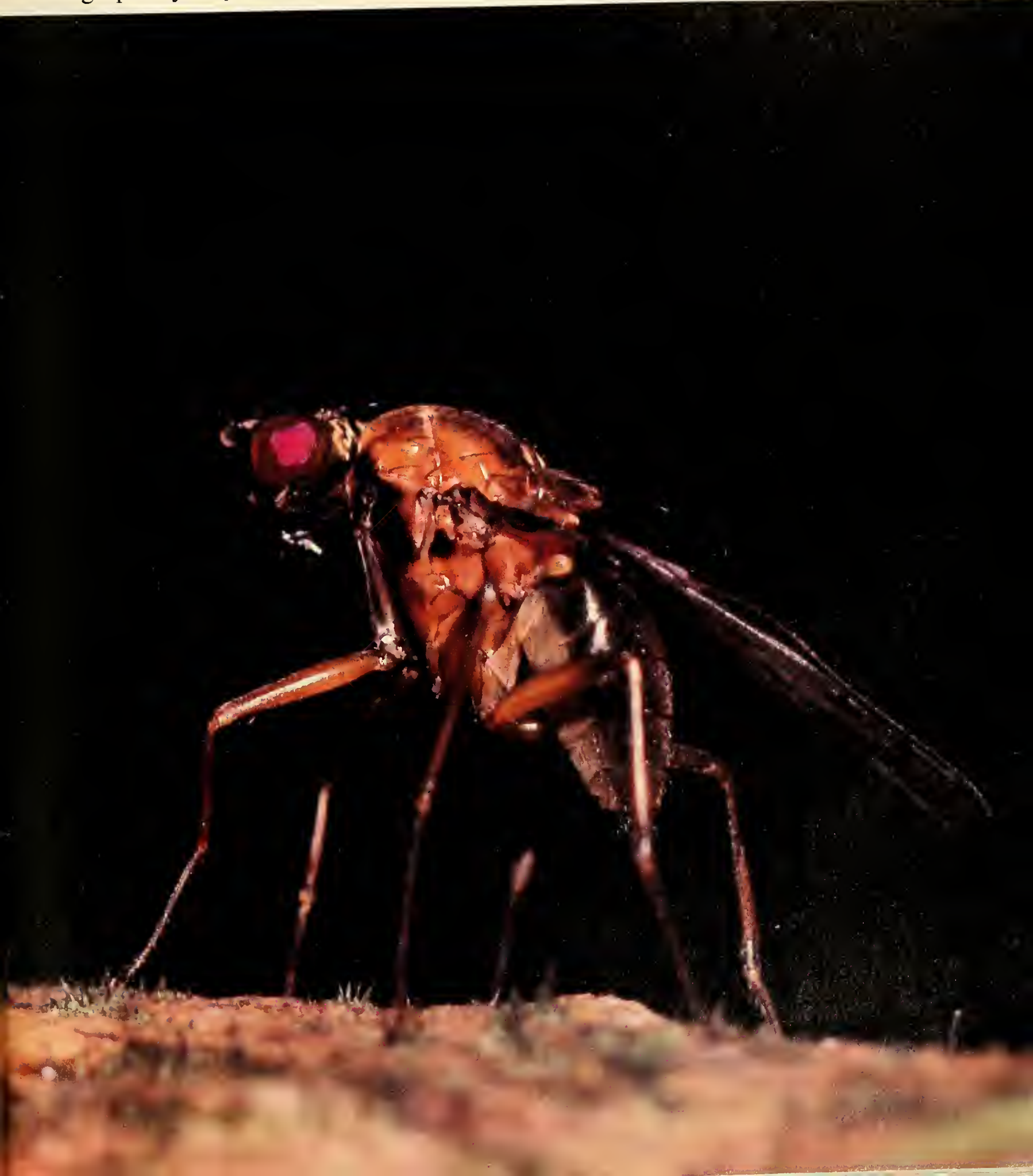
Some of the first changes among the early colonizers are in courtship and mating behavior patterns. Such behaviors evolved to allow mate recognition within single interbreeding populations and play an important role in maintaining the integrity of each population's gene pool. Courtship behaviors are important in assuring, with high probability, that the mating between two individuals will result in the best genetic combination for the survival of their offspring.

The most visible indicators of the importance of courtship in the speciation of Hawaiian Drosophilidae are the elaborate behaviors and morphological structures manifested by the males of this group. *Drosophila clavisetae* exemplifies the intricacy of the courtship dance performed by Hawaiian pomace fly males and the morphological changes that have occurred in response to sexual selection. Biologist Elwood Zimmerman described it in the following way: "Few persons are so fortunate to see such wondrous things as [the] male *Drosophila* which has evolved huge scent-dispersing brushes at the end of his tail which he curls over his head and shakes at his lady love to overwhelm her with a shower of aphrodisiac perfume."

Before mating can occur, male pomace flies must perform other chores as part of their lek behavior, which was discovered by Herman Spieth of the University of California at Davis. A lek is an area made up of several adjoining territories from which males display to attract receptive females. (Lekking was first described in

Photographs by Raymond A. Mendez

*A male pomace fly (*Drosophila cyrtoloma*) takes up a station in his breeding territory. Several males hold adjoining territories and the area, collectively called a lek, serves as a magnet for females.*



The sap exuding from this tree is fed upon by two species of pomace fly, D. silvarentis *and* D. heedi. *To partition a scarce resource, however, one species lays its eggs in the slime flux on the tree; the other in the material that has dripped onto the ground.*

birds such as the sage grouse of North America and the bird of paradise of Papua New Guinea.) At a lek of Hawaiian pomace flies, males of a given species establish and defend territories on leaves, stems, or limbs of plants.

The males of each species have developed unique patterns of aggressive behavior, which may in turn be responsible for some of their ornate secondary sexual characteristics. For example, the males of *D. heteroneura* have a mallet-shaped head that has presumably evolved in response to the way in which male–male aggression takes place. Males of this species will stand head to head and, like two rams, butt and shove until one turns or flies away. Another species, *D. nigribasis*, puts on a more delicate performance in defense of its territory. The males stand with their legs and wings fully extended, giving the appearance of standing on tiptoes with wings stretched to the sky. In this position, and facing head to head, the males rock slowly from side to side, alternately touching their wing tips until one leaves the scene. Males that succeed in establishing themselves in a territory will then advertise their presence—by waving their wings or, in some cases, through pheromones—to attract sexually receptive females.

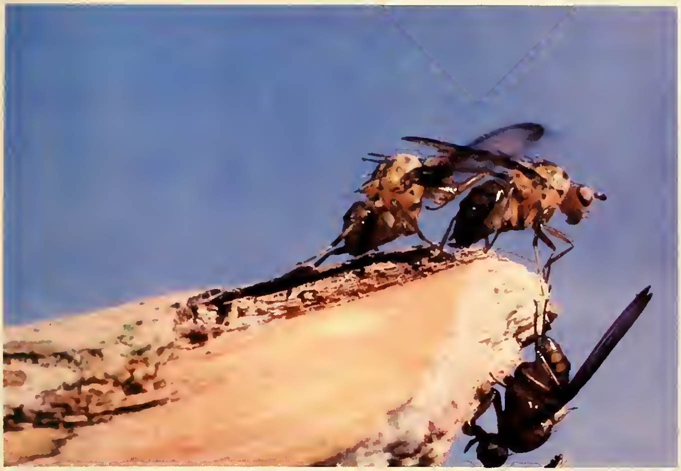
Kenneth Kaneshiro has hypothesized that during the first few generations of new colonizations, when the population size is very small, interspecies interactions are either rare or nonexistent, allowing a relaxation of the normal mate-recognition system. Under these conditions females that are less discriminating in mate selection will be those contributing the most progeny, carrying their genes to the next generation. Females that are too discriminating will be less likely to mate, resulting in a shift in the genetic basis of the mate-recognition system and thus in a simplification of the mating ritual.

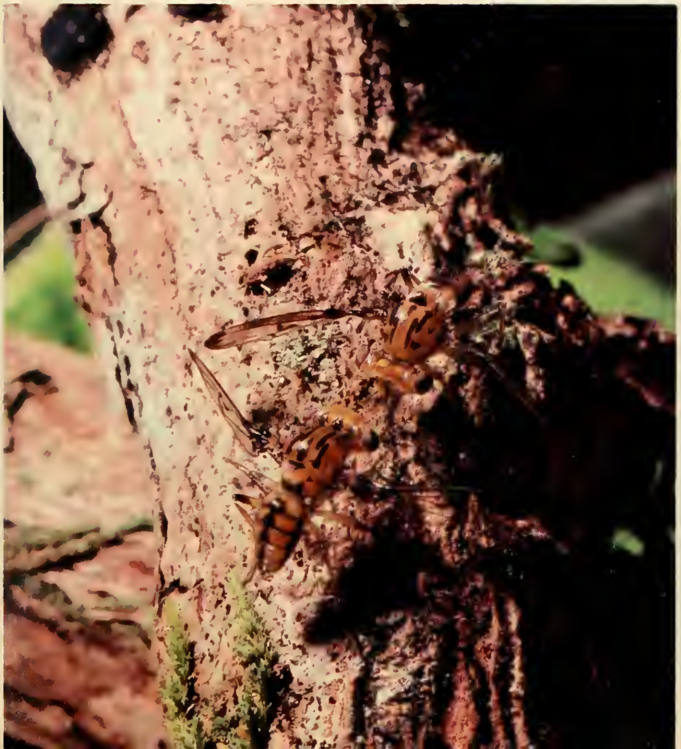
Because the Hawaiian fly populations are the products of founder colonizations, the initial changes that did occur in the mate-recognition system were strictly random. Thus, if two populations were separately formed by independent founder events from a common ancestral species, the resultant simplifications in the courtship behavior of these populations may have differed to some extent.

Our data indicate that such behavioral changes have occurred in derived populations. We have observed that males of a newly derived population are not able to satisfy the courtship requirements of females from an ancestral population, probably due to the more simplified courtship display of the males. On the other hand, females from the derived population readily accept the courtship rituals of ancestral males, presumably because the males display a courtship repertoire that more than satisfies the females' simplified tastes. This one-sided mate preference between two populations can influence the direction of evolution among closely related species or among isolated populations of the same species. We are attempting to verify our hypothesis by finding the specific changes in courtship behavior that occur within isolated populations of a single species.

The usual forces of natural selection regain their importance in the evolutionary process as the size of a colonizing population increases and other related species are encountered. The increase in interactions with other species results in an increase in the complexity of the courtship rituals to insure species recognition. Thus, we would expect that, in general, older species complexes would tend to have more elaborate courtship patterns than the more recently derived complexes. This is indeed the trend among the picture-winged species group of Hawaiian *Drosophila*. Chance events, then, are responsible for a rapid rate of evolution over a relatively short period of time, while selective forces act at a reduced rate over a

Courting a female, a male pomace fly buzzes his wings in an attempt to make her receptive to breeding, below. Two males of the species Drosophila heteroneura *engage in a fight over territory, bottom. They use their mallet-shaped heads to butt each other. Eventually, one dominates and the vanquished male flies away.*



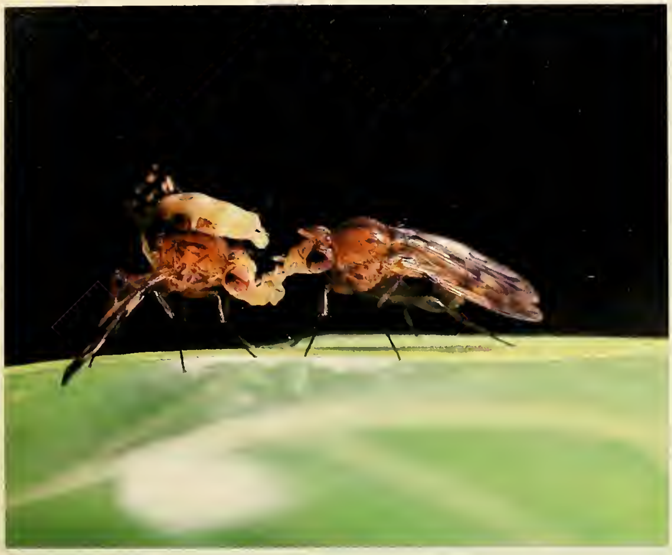


longer period and result in the diversity among the species we see today.

The ovipositional behavior of the adult female has become the second major focus of our project to determine the forces controlling evolution in the pomace flies. Individuals of the insect order Diptera (true flies) undergo complete metamorphosis and have four distinct life cycle stages—egg, larval, pupal, and adult. In most species, the feeding sites of the adults are more diverse than those of the larvae. This is because larvae are much less motile and so are confined to the substrate in which the eggs are laid. The larval feeding site is therefore the same as the breeding site of the species.

The early pioneering work of William Heed of the University of Arizona and the later work of Steven Montgomery of the University of Hawaii have provided us with an overview of the variety of breeding sites to which these flies have adapted to avoid competition, predation, and desiccation, while maximizing the availability of resources. The decaying bark, leaves, stems, and roots of the native Hawaiian plants are the primary breeding sites for the majority of pomace fly species. Others include ferns, fungi, flowers, fruits, and sap exudates (slime fluxes) produced by a few species of native trees. One genus of flies (*Titanochaeta*) has even adopted a parasitic life form, its larvae feeding on the eggs of spiders.

One of the best examples of an adaptation into separate ecological niches, resulting in the avoidance of competition, is the relationship between two very closely related picture-winged species, *D. silvarentis* and *D. heedi*. The females of these species are morphologically indistinguishable from one another, although the males can be recognized by differences in the bristle patterns on the forelegs. Moreover, these species have the same or overlapping ranges over parts of the Big Island of Hawaii. In the dry forest area of the saddle between two large volcanoes, Mauna Kea and Mauna Loa, where virtually no standing water exists and precipitation is quickly taken up or evaporated, both species feed on the slime flux exuded by the native *Myoporum* trees.



Below: Tasting the tongue of her prospective mate, a female D. clavisetae *is partner to one of the most intricate courtship rituals among the pomace flies. Facing page: The male, identified by the brushlike structures at the end of his body, uses his elaborate appendage to shower the female with a scent that acts as an aphrodisiac.*

Eggs and larvae are also present in the fluxes. We removed these fluxes and brought them to our laboratory where the eggs and larvae present in them were allowed to develop to the adult stage. Surprisingly, all the adults were *D. silvarentis*; the location of the breeding site of *D. heedi* remained a mystery. On a subsequent field trip, we discovered a dark patch of wet soil. This soil patch was moistened by a slime flux dripping from a horizontal branch of a *Myoporum* tree high above, and in it were *D. heedi* larvae and pupae. The ovipositional behavior of one of these species has evolved to allow a partitioning of scarce resources.

Two other picture-winged species, *D. grimshawi* and *D. crucigera*, possess properties that make them ideal for the study of ovipositional behavior. These are the only two drosophilid species of the picture-winged group not endemic to a single island. *D. grimshawi* inhabits all the major islands except Hawaii, and *D. crucigera* inhabits the islands of Kauai and Oahu.

Populations of *D. grimshawi* found on Maui, Molokai, and Lanai and *D. crucigera* throughout its range are the only generalists in the picture-winged group. The majority of picture-winged species are highly host specific, utilizing only one to five plant families for oviposition sites. *D. crucigera* breeds on twenty-one plant families, while *D. grimshawi* utilizes approximately ten.

On Kauai and Oahu, where *D. crucigera* is found together with *D. grimshawi*, the latter is a specialist, laying its eggs only on the plants of one genus. But on the islands of Maui, Molokai, and Lanai, which *D. crucigera* has not colonized, *D. grimshawi* is a generalist. This suggests that competition for food resources is responsible for the niche separation between these species. An evolutionary trend from generalism to specialization is in keeping with the popular ecological thought that populations will evolve toward the optimal use of the available resources. Geologic and behavioral data, however, indicate that the Kauai *D. grimshawi* population is the most ancestral and the one from which the generalist populations on Maui, Molokai, and Lanai evolved. The implication is that, in this case, evolution has occurred in the reverse direction.

In the laboratory, the generalist females will oviposit in vials containing our standard laboratory food medium, but females of specialist populations will only lay eggs on or adjacent to a piece of properly rotted bark of their specific host plant. This behavioral characteristic allows us to distinguish between generalist and specialist females. Thus, we are able to investigate the genetic basis of ovipositional behavior by testing hybrid females for host specificity. Furthermore, hybrid females resulting from generalist and specialist crosses are nearly all fertile, and the males are at least partly so, making it possible for us to estimate the number of genes governing this behavior.

We have only recently begun to investigate the selective forces and the genetic elements involved in the evolution of host specificity. However, some preliminary data have been obtained from hybridizations carried out on several populations of *D. grimshawi*. These data indicate that the genetic basis of the generalist ovipositional behavior is dominant to that of the specialist, and that this behavior may be regulated by a single gene. If such important behavioral components are regulated by simple genetic elements, adaptive shifts can occur rapidly and provide a beginning for the speciation process.

In summary, it appears that the Hawaiian Drosophilidae have the genetic capability to differentiate and adapt rapidly to the diversity of environmental conditions present on the islands of Hawaii. Although chance events may be primarily responsible for rapid behavioral changes during the early stages of colonizations, selective forces are probably largely responsible for directing change when the population size becomes large and competitors and predators are encountered more frequently. Indeed, our studies indicate that a small number of genetic elements may be responsible for changes in both ovipositional behavior and courtship behavior and that such changes may be partly responsible for the remarkable speciation among these flies. An exceptional capacity for rapid genetic change helped the Hawaiian Drosophilidae successfully colonize the islands of Hawaii. ☐

The goby Awaous stamineus *lives in the lower reaches of Hawaiian streams. Although capable of swimming, the fish uses its pelvic fins to "walk" on the bottom while searching for its food.*

Life Crawls Upstream

Fish, shrimp, and snails have literally climbed out of the ocean to colonize Hawaii's freshwater streams

by John I. Ford and Robert A. Kinzie III

Photographs by Raymond A. Mendez

Although scientists have been intrigued by Oceania's reef fishes and marine invertebrates for at least a century, little attention has been given to the freshwater life of oceanic island streams. At first glance the fauna inhabiting such streams may appear drab in comparison with reef fauna. But these creatures deserve a second look, for the indigenous fishes, crustaceans, mollusks, and insects that populate freshwater streams must be credited with some of the most startling evolutionary accomplishments of the island biota.

Animals and plants vary in their ability to tolerate salinity; therefore, only a few forms are able to cross the saltwater barrier to reach oceanic islands. Familiar fish from continental rivers—such as carp, minnows, sunfishes, crappies, and bass—are absent from oceanic islands, because these primary freshwater fishes are physiologically incapable of surviving transoceanic crossings. Sheer distance makes the colonization of oceanic islands improbable even for many secondary and peripheral freshwater fishes (those normally confined to fresh water but capable of intermittent exposure to high salinities). In fact, except for introduced species, there are no truly freshwater fishes anywhere in Oceania. Thus, Oceania's aquatic biota, like its terrestrial counterpart, represents a very limited number of families.

Where do stream fishes of Oceania come from, and what has allowed colonization of these streams, which may be considered as islands within islands? To learn more about the process involved in colonizing these habitats, we have been studying the ecology of Hawaiian streams and making comparative observations in streams and estuaries in the Samoan, Caroline, and Mariana archipelagoes.

Simply put, the stream-dwelling fishes, crustaceans, and some of the snails came from the ocean. They are descendants of marine forms that, each in its own fashion, colonized stream habitats. There they have adapted physiologically to fresh water and to the precipitous and intermittently torrential stream environments that are common on the islands.

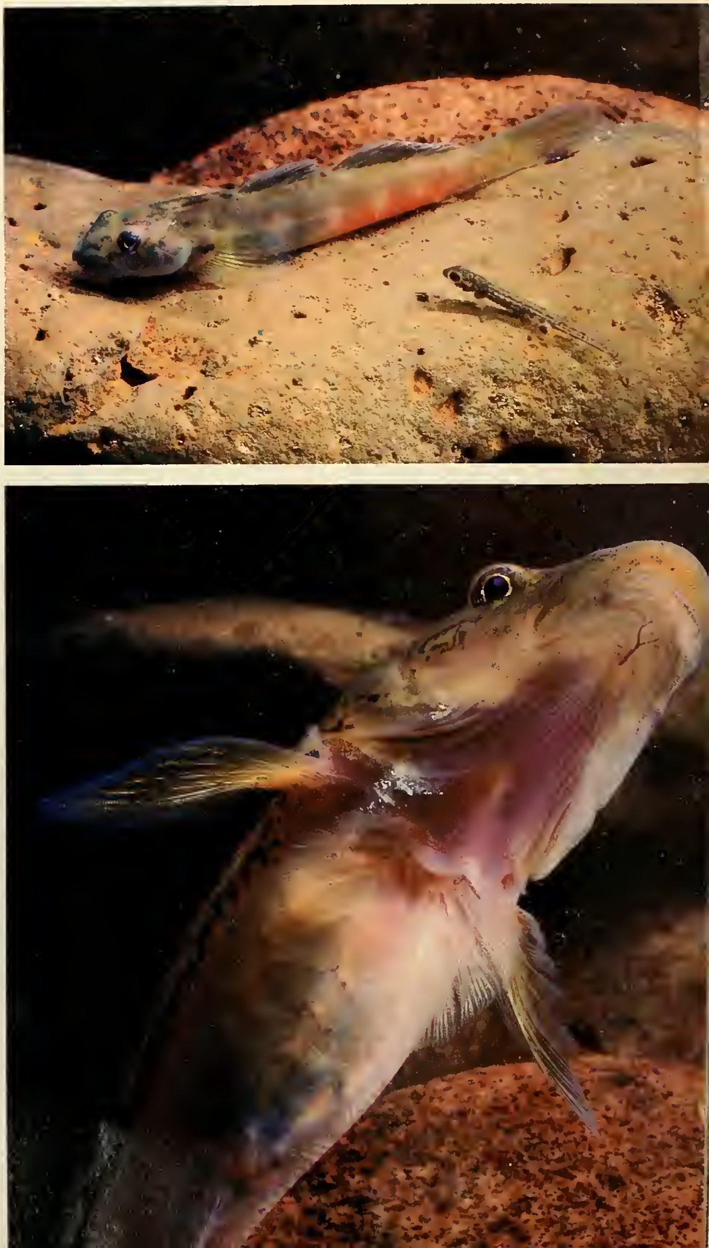
To understand the selection pressures influencing island-stream animals, one must first understand some features of the island watersheds. Volcanic islands in Oceania tend to have very porous rocks, and much of the rainfall, which is patchily distributed both seasonally and spatially, disappears rapidly below the surface. Streams are flashy—they are subject to suddenly increased flows, rising from less than a cubic foot per second to peak flows in excess of 1,000 cubic feet per second, that typically last only a few hours. There are also frequently prolonged periods of low flow that result in elevated water temperatures and local reductions of usable habitat. Many streams reach the ocean only after a heavy rainfall in the mountains. These intermittent streams put totally different stresses on their inhabitants than do continuously flowing streams. A second feature of many streams is a precipitous gradient. Rapids, small cascades, waterfalls, and riffles are the norm. These streams are also exceedingly small by continental standards.

Gobies are the most typical stream fishes of oceanic islands. Many shore and tidepool goby species inhabit the surrounding seas. For these marine forms, tolerance to influxes of fresh water resulting from tropical downpours is probably an important trait—one that may have served as a preadaptation for entry to freshwater life. Even more crucial may have been the feature that distinguishes these fish—the fused pelvic fins that form a strong suction disk, enabling gobies to cling to rocks in the shallows where crashing waves would otherwise sweep them away. This morphological adaptation, in conjunction with an ability to withstand lowered salinities, may have opened the pathway to freshwater habitats.

Acclimation to fresh water is certainly no unique evolutionary innovation. Migratory species such as salmon and eels make journeys between fresh water and salt water during their life cycle. Some species, such as bonefish, mullet, and jacks, are able to make the necessary physiological adjustments repeatedly throughout their lives. In fact, several marine species periodically invade the lower reaches of streams in Oceania to feed on plants and animals. The major distinguishing feature of gobies inhabiting streams is that they spend their entire adult lives in fresh water, and all but a few breed there as well. Their life history retains an evolutionary remnant of their marine past, however. As far as we know, all these fish are diadromous: they are physiologically and behaviorally confined to fresh water as adults yet must spend their larval lives as inhabitants of the sea, as members of the marine zooplankton community. All four species of Hawaiian freshwater gobies and the closely related eleotrid, which lacks fused pelvic fins, exhibit this pattern, a form of diadromy most appropriately called amphidromy.

Spawning takes place in the streams. At least one of these species is known to make a downstream migration to spawn in either fresh or estuarine waters. (The early Polynesians took advantage of this event, triggered by the rainy season's first torrents, to seek out the choice ripe gobies swarming in the lower reaches of the streams.) Female fish attach hundreds of tiny eggs, each less than one millimeter in diameter, to the surface of rocks where

Found only in Hawaii, Lentipes concolor, *below, inhabits the middle and upper sections of perennial rivers. The adults spawn and live out their lives in fresh water. Their offspring, however, are swept out to sea while in the larval stage. After weeks or months as members of the marine zooplankton community, the young gobies return to fresh water, overcoming such obstacles as steep gradients and waterfalls. The fused pelvic fins of* Awaous stamineus, *bottom, can be used as a suction cup, enabling the fish to rock-climb its way from the sea to freshwater streams.*



Found at elevations of up to 1,200 feet, the endemic freshwater snail Neritina granosa *must spend part of its life cycle in the ocean. Larvae are carried out to sea shortly after hatching. After several weeks, the tiny snails make their way back from the sea to the stream where they will remain as adults.*

they are fertilized by an attendant male. Within a short time, apparently as little as twenty-four hours, the eggs hatch and the microscopic larvae are swept downstream and into the sea. To survive, the larvae must reach the sea quickly. We know next to nothing about the subsequent life history of the larvae.

Weeks or even months later, the goby fry, called *hinana* by the Hawaiians, are first seen in the lower reaches of streams. At this time, they are less than two centimeters in length and without pigment, except for their relatively large eyes. These tiny larvae manage to make their way inshore to a stream mouth, penetrating through the surf zone and swimming against the outrushing stream. What happens next is even more astounding. Many streams along rugged lava coastlines drop steeply, cascading into the sea, or even enter the ocean as high falls. Were the fry to remain below the falls, not only would they be easy prey for nearshore marine predators, but they would also never reach the fresh water necessary for maturation and breeding. The tiny fry must surmount steep gradients and cascading water if they are to reach their adult habitat.

Our observations indicate that at least two goby species make this upstream journey when they are very young (less than three centimeters in length). The secret? The "suction cup" pelvic fins, which are so important to marine gobies in the surge zone, have been put to a new use. By alternately clinging tightly with their fins and squirming forward using their tail, the gobies are able to climb the waterfalls. Goby fry have been observed climbing up a smooth vertical surface at a rate of eighteen inches in twenty seconds and hanging upside down as they progress up the undercut faces of waterfalls.

Are the closest relatives of these Hawaiian gobies found in the nearshore environment, as would appear logical? The situation appears to be more complicated than that. Taxonomic work on the goby family —the freshwater species in particular—is in a state of flux. Of four species of true gobies that inhabit Hawaiian streams, two species, *Lentipes concolor* and *Sicydium stimpsoni*, are found only in Hawaii. These fish normally live in the middle and upper reaches of perennial rivers. Another goby, *Awaous stamineus*, and the eleotrid *Eleotris sandwicensis* may be endemic, but they are very similar morphologically to forms living in other island streams of the Indo-West Pacific region (and have been reported to occur infrequently throughout that area in past literature). The eleotrid, which is confined to stream reaches below the first waterfall because it has no sucking disk, and *A. stamineus*, the species that makes the downstream spawning migration, live in the lower reaches. Another goby, *A. genivittatus*, a widely distributed Indo-West Pacific species, lives in estuaries and the terminal reaches of streams.

We believe that transport between the Hawaiian Islands takes place by dispersal of the larval forms by coastal currents. The appearance of fry at any given stream mouth and subsequent recruitment of individuals into the stream's population is a matter of chance. We also believe that unlike anadromous salmon, which return to the stream of their birth as strongly swimming adults, the gobies move into the nearest stream when it is time for them to metamorphose into their freshwater form. Metamorphosis and settlement are probably triggered by contact with waters of reduced salinity near stream mouths. Goby fry may swim up either perennial or intermittent streams during periods of heavy water flow, and apparently cannot distinguish between the two types of streams. Those that become trapped in the stagnant waters of an intermittent stream die and are lost from the gene pool.

Hawaii, the most isolated of the island groups in the Pacific, has only these four

The native Hawaiian species of stream shrimp has a diadromous life cycle; having hatched in fresh water, the larvae go to sea for a period of development. Tiny postlarval shrimp manage to climb waterfalls by using mosses and ferns as ladders. Adults can be found in streams at altitudes as high as 3,300 feet.

gobies and the single species of eleotrid living in its freshwater streams. As the distance from the Indo-Malaysian region (the likely source of colonists) decreases, island groups have more species of stream macrofauna. For example, Samoa has at least two eleotrids and eight gobies in its tiny mountain streams. Recent surveys on Ponape have found five eleotrids and at least nine goby species. Palau, about 500 miles east of the Philippines, harbors nine eleotrids and thirteen species of gobies. We suspect, therefore, that the endemic Hawaiian gobies are not derived from any Hawaiian marine gobies but stem from colonists of the same genera that reached the Hawaiian archipelago by chance from islands in the western Pacific.

If the appearance of colonizing juvenile gobies at stream mouths were infrequent enough, the stage would be set for the classical pattern of speciation by isolation and divergence. That at least two and possibly four of the Hawaiian gobies are endemic indicates that their populations have indeed been geographically separated from the founder population. Because populations are not isolated within the archipelago, radiation has not occurred within Hawaii. Retention of diadromy has insured larval dispersal throughout the archipelago, reducing the potential for divergent evolution.

Many of the Pacific freshwater invertebrates have life histories virtually identical to those of the fish. The native species of stream shrimp that lives in Hawaii also has a diadromous life cycle. Embryos are carried on the swimmerets of females until they hatch. Larvae are then swept out to sea, where they spend up to three months as part of the marine zooplankton. When they attain the proper stage of development, the larvae return to a stream mouth where they lose their planktonic characteristics and assume adult morphology. We have seen thousands of tiny postlarval shrimp among the cobbles of a rocky beach, moving through the brackish water and into the mouth of a stream. This shrimp, known locally as *opae kalaole*, or "spineless shrimp," has been found at elevations of up to 3,300 feet. We have observed postlarval *opae* creeping up the face of waterfalls by using wet mosses and ferns as ladders. This species is the most abundant of the native stream animals in Hawaii.

Like the gobies and many other island organisms, freshwater shrimp show a diminution of species diversity with increasing distance from the rich Indo-Malaysian faunal province. Guam has at least four species of shrimp, Samoa has six, and Ponape at least eight. We suspect that the origin of the endemic Hawaiian spineless shrimp can be explained by the same hypothesis applied to the gobies.

In 1956 the Tahitian prawn, *Macrobrachium lar*, was introduced into two Hawaiian streams. This species is found naturally in East Africa, the Indo-Malaysian area, the Ryuku Islands, Guam, Tahiti, and the Marquesas. Like the native crustaceans, the Tahitian prawn has a diadromous life cycle. The effectiveness of coastal currents around the Hawaiian Islands in dispersing larvae has been dramatically demonstrated by this species. Within ten to fifteen years of its introduction, the Tahitian prawn was found in virtually every Hawaiian stream that flowed to the sea. This clearly shows that the diadromous strategy of the freshwater species prevents the isolation of populations within the archipelago. While the breeding adults are confined to individual drainages and thus are restricted in their movements, movement of the larvae both reduces genetic isolation and makes possible the colonization of other Hawaiian streams. Once again, this phenomenon accounts for the absence of radiation within the archipelago.

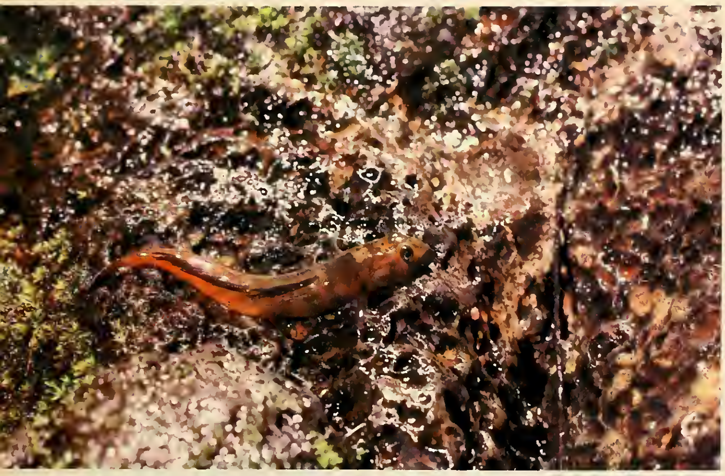
Diadromy has also been adopted by a group of large freshwater snails that, like the fishes and crustaceans, appear to have invaded freshwater habitats from the sea. The endemic Hawaiian species *Neritina granosa* deposits egg capsules on rocks at the bottom of streams and on the shells of other snails. Within thirty days, hundreds of larvae hatch and are carried out to sea. Some weeks later, tiny snails only a millimeter long appear in the stream mouth and begin their upstream migration. This freshwater snail has been found at elevations above 1,200 feet.

Female Tahitian prawns carry their eggs on a series of swimmerets. When the larvae of this introduced species float to sea, coastal currents carry them to other islands. The young prawns can then colonize any freshwater streams that flow to the sea. As a result, this species has spread throughout most of the Hawaiian Islands.

Theodoxus vespertinus, a close relative of *N. granosa*, is restricted to estuaries and brackish waters. In addition, there are a number of marine intertidal snails in Hawaii that are closely related to the two stream species.

Many of the important orders of freshwater insects are absent in Hawaii. There are no native caddisflies, dobsonflies, mayflies, or lacewings. Only a few aquatic beetles and true bugs are represented in the freshwater insect community. On the other hand, Hawaiian dipterans (true flies) have radiated extensively in aquatic habitats. A prime example of specialization in Hawaiian stream insects is provided by the damselflies. On the island of Kauai alone, at least seventeen species of damselflies have been found that occur there and nowhere else in the world. New species continue to be described. Interest-

Two species of Hawaiian gobies, Lentipes concolor, *below, and* Sicydium stimpsoni, *right, demonstrate their rock-climbing ability. These fish can negotiate a smooth, vertical surface at the rate of eighteen inches in twenty seconds.*



ingly, one species of this typically aquatic group has left the stream habitat and become arboreal. The nymphs of *Megalagrion oahuense* live in the tiny pools of water that collect in the leaf axils of a native plant that grows in the wet mountain forests of Oahu. Another intriguing insect group is the chironomid brine flies. In most parts of the world, this group consists of species living on decayed plant matter in the marine intertidal zone. In Hawaii, brine flies have also moved from the sea into streams. Several species are restricted to freshwater habitats, thereby mirroring the upstream movements of the fishes, crustaceans, and snails.

Oceanic island streams provide a model of island biology. A habitat that was originally almost devoid of animal life gradually accumulated species as certain marine forms, which were preadapted to the conditions found in streams, evolved and began to exploit the new environment. A notable feature of the oceanic island stream communities is that the number of species found in any archipelago is roughly in inverse proportion to the distance from the Indo-Malaysian region. The diluting effect of distance, well documented for terrestrial animals and plants, also affects the number of species in streams. In Hawaii, the evolutionary history of the diadromous species tends to reflect the moderate level of endemism present in the marine shore fauna. But the endemic aquatic insects of the archipelago have demonstrated the higher degree of speciation characteristic of Hawaii's terrestrial biota.

The stream biota is representative of island ecosystems in another way: its vulnerability to human influence. Fresh water is a precious commodity on most islands, particularly where agriculture is extensive and urban centers are expanding. Throughout the streams of Oceania, habitats are being irreparably altered and water is being diverted from stream channels. Since most human activity on these islands is concentrated in the lowlands, the changes are greatest there. But even if the upper reaches of the streams remain pristine, if the lower reaches are made uninhabitable by water diversions, channel alterations, or pollution, vital access to the sea is lost and the native fauna suffers. Maintenance of streambeds and water quality is necessary to insure that the streams can retain populations of these unique animals. New initiatives in Hawaii to protect streams hold promise that the natural habitats where such extraordinary evolutionary feats have been achieved will not be destroyed. ☐

The Next Island

Loihi, an underwater volcano, is at the beginning of its life cycle. It is expected to surface someday and join the Hawaiian group

by William R. Normark, David A. Clague, and James G. Moore

The Hawaiian Islands form a linear chain that extends for about 2,100 miles in the central Pacific Ocean. The chain then makes a sharp bend to the north and continues as the Emperor Seamounts for approximately another 1,500 miles. The eight major and numerous smaller islands of the Hawaiian chain are of volcanic origin; the largest and most volcanically active is the southeasternmost island of Hawaii, known as the Big Island. Mauna Loa, Kilauea, and Hualalai, all active volcanoes, are on the Big Island.

Only about thirty miles southeast of the Big Island is Loihi, an underwater volcano discovered in the 1950s. In 1971–72, a swarm of earthquakes was recorded in the vicinity of Loihi and a second swarm was recorded in the same vicinity in 1975. This geologic activity, in combination with our understanding of the origins of the Hawaiian chain, suggests that Loihi may someday emerge from the sea to join the Hawaiian group as its newest island.

The explanation of the origin of the Hawaiian Islands rests mainly on two theories. The first was the proposition made in 1963 by the Canadian geophysicist J. Tuzo Wilson that these volcanic islands formed when a lithospheric plate moved over a "hot spot"—a source of magma, or melted rock—located deep inside the earth. The second theory, put forth in 1971 by W. Jason Morgan, a geophysicist at Princeton University, is that the hot spots of the world are stationary with respect to one another. Taken together, these theories suggest that the apparently youngest volcano in the Hawaiian chain, the underwater Loihi, lies directly above a hot spot, and that the older volcanoes in the group have been progressively carried away to the northwest by plate movement.

At about the same time as Wilson's work, an Australian scientist determined the ages for a number of volcanoes in the Hawaiian Islands by means of potassium-argon radiometric dating. His results quantitatively confirmed the observation by James D. Dana, a nineteenth-century naturalist, that the islands did indeed increase in age to the northwest and showed that the rate of plate movement was about four inches a year.

Studies made in the last ten years indicate that the bend in the Hawaii-Emperor chain is 42 million years old and records a major change in the direction of Pacific-plate motion at that time. The Emperor Seamounts are believed to have formed between 70 and 42 million years ago, when the Pacific plate moved in a northerly direction.

These early studies document an amazingly consistent pattern, with volcano after volcano following nearly identical phases of construction, which build a volcano above sea level before erosive processes and subsidence slowly transform the high islands into small pinnacles of rock. Later, with more subsidence, coral reefs grow over the last rocky pinnacles and form an atoll similar to Midway Island. With continual subsidence, the reef eventually dies, leaving a submerged, flat-topped, reef-capped volcano, called a guyot, such as Koko Seamount in the southern part of the Emperor chain.

In order to learn more about the birth and early life of Hawaiian volcanoes, we determined to study Loihi at firsthand. In 1978 we were able to get cruise time aboard the U.S. Geological Survey ship *S.P. Lee*, sailing from Honolulu. A deep-sea camera was towed across the top of the Loihi, some 3,000 feet below sea level, followed by a dredge haul up the west flank to the volcano's flat summit plateau. The dredge is a heavy steel frame supporting a steel-chain bag and is suspended from the ship by a half-inch steel-cable. When dragged across the sea floor, the dredge breaks off pieces of exposed rock and scoops up loose rock fragments.

Our first Loihi dredge was filled to overflowing. It contained a quarter-ton of fresh, young pillow-lava fragments with glistening glassy margins. Lava that erupts under water commonly forms pillows, rounded structures whose outer margins are quenched by seawater to form volcanic glass. When fresh, these fragile glassy margins indicate that the lavas are quite young. Mixed with the Loihi lava were rust-red clayey hydrothermal materials that coated about 20 percent of the rocks in the dredge. The 70mm film from the camera traverse showed that the sum-

Lava spews from Kilauea volcano on Hawaii. Kilauea probably emerged from the sea less than 100,000 years ago and still overlies the subterranean hot spot that produced the Hawaiian chain. It is drifting northwest about four inches a year.

D.W Peterson, USGS

mit of Loihi consists of fresh, glassy, unsedimented pillow lavas. Both photographs and dredge samples confirmed that Loihi is indeed a young, growing volcano.

With interest in Loihi aroused, the 1971–72 and the 1975 earthquake swarms in the Loihi region were studied again, leading to important new results. These swarms began with small quakes that occurred in short bursts restricted to a small area near the summit of the submarine volcano. In the following weeks or months, the earthquake activity migrated to the flanks of the volcano and occurred over a broader area, and the individual quakes generally became stronger. This overall pattern is remarkably similar to that accompanying eruptions of the neighboring Kilauea volcano.

When seismologists examined the distribution of deep earthquakes in the general area of Hawaii Island—those from about twenty to forty miles below the earth's surface—they found a broad, diffuse zone of quake centers, some fifty miles in diameter, centered north of Loihi near the coast of Hawaii Island, where earthquakes are often associated with bursts of deep harmonic tremor, a peculiar rhythmic seismic motion caused by the deep flow of magma. The center of the deep earthquake zone is nearly equidistant from Mauna Loa and Kilauea, the most active volcanoes on Hawaii, and Loihi, and the zone underlies the summits of all three volcanoes. Hence, the area of deep earthquakes may define the location and size of the upper part of the Hawaiian hot spot.

The picture of Loihi revealed by oceanographic and seismic evidence sparked the further interest of scientists eager to study an active oceanic hot spot volcano. Late in 1980, scientists from the National Ocean Survey (NOS) and the University of Hawaii used ANGUS, a special bottom camera system developed at the Woods Hole Oceanographic Institution, to look at Loihi's summit. They found that the top of Loihi is indented by a giant crater, or caldera, similar to those at the summits of the other active Hawaiian volcanoes, and that submarine hot springs occur within this summit caldera.

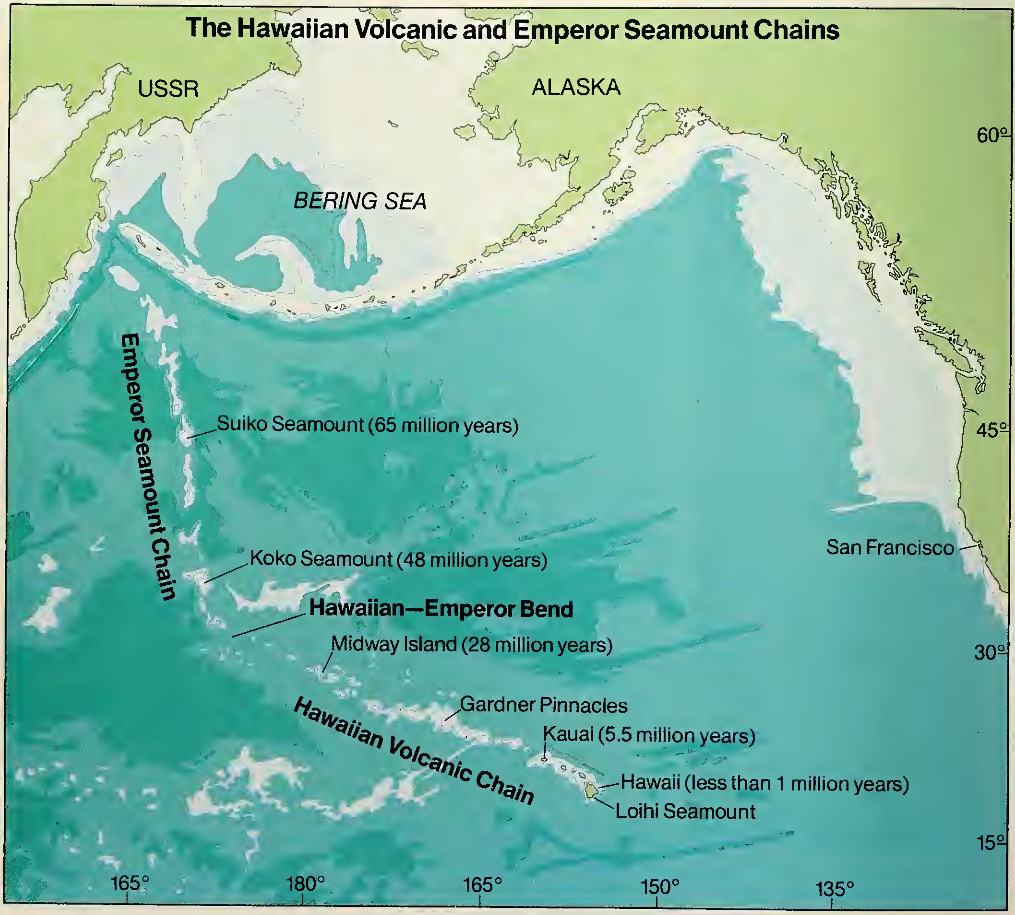
When erupting underwater, lava commonly forms rounded pillows; these were photographed on the northern edge of the Loihi crater at a depth of about 3,000 feet.

Alexander Malahoff, National Ocean Survey, NOAA

In February 1981, we used a research vessel operated by the University of Hawaii to conduct an exhaustive dredging program on the summit and rift-zone ridges of Loihi to supplement the samples in hand from the single 1978 dredge. Such samples could reveal something about the birth of a new volcanic system atop a hot spot. On the transit, we briefly stopped and dredged volcanic rock from the northwest rift zone of Hualalai volcano on the west side of the island of Hawaii. At the time, Hawaiian volcanoes were thought to progress through a series of eruptive phases. In the earliest phase, the main shield volcano is constructed by the rapid ejection, first as submarine and later as terrestrial eruptions, of large amounts of fluid tholeiitic basalt, a kind of lava. This stage is followed by collapse of the summit caldera and eruption of small amounts of less fluid alkalic basalt and related lavas. The final eruptive stage occurs after a period of volcanic quiescence and erosion lasting from 0.5 to 2.5 million years. Lavas ejected during this final, posterosional stage are even less fluid, of very small volume, and strongly alkalic, with low contents of silica and high contents of the alkali metals sodium and potassium. Because the terrestrial portion of Hualalai volcano on the island of Hawaii is completely covered by alkalic lavas of the second eruptive phase, it was not known

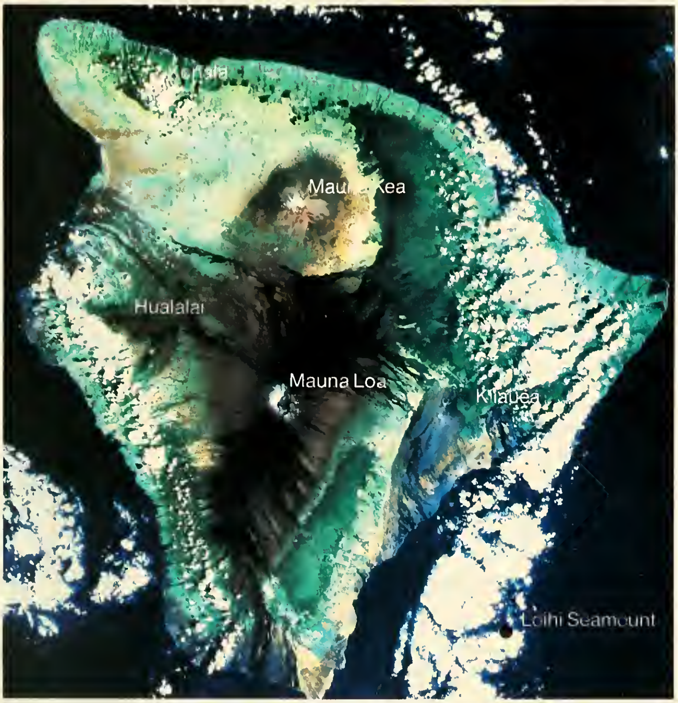
The islands, pinnacles, and subsurface seamounts of the Hawaiian and Emperor chains increase in age to the northwest. All apparently formed when the Pacific lithospheric plate moved over a stationary volcanic hot spot, over which the island of Hawaii is now passing. The Hawaiian-Emperor Bend resulted from a shift in the direction of plate movement some 42 million years ago. As the islands drift away from the hot spot, erosion and subsidence will gradually shrink them into pinnacles and then seamounts.

Andrew Tomko


The Hawaiian Volcanic and Emperor Seamount Chains
USSR
ALASKA
BERING SEA
60°
Emperor Seamount Chain
Suiko Seamount (65 million years)
45°
Koko Seamount (48 million years)
San Francisco
Hawaiian—Emperor Bend
Midway Island (28 million years)
30°
Gardner Pinnacles
Hawaiian Volcanic Chain
Kauai (5.5 million years)
Hawaii (less than 1 million years)
Loihi Seamount
15°
165°
180°
165°
150°
135°

whether this volcano actually had a shield volcano of tholeiitic basalt hidden beneath the alkalic lavas or if the entire volcano might be composed of alkalic lavas. The six dredges on the submarine flank of Hualalai all recovered tholeiitic basalt and confirmed the model of Hawaiian volcanic stages just described.

We expected that the lavas recovered from Loihi would be tholeiitic basalt but believed subtle variations in lava chemistry would reveal how hot spot volcanoes first begin the task of building an island. Winches and dredges were made ready and a mood of anticipation gripped the ship's company, seamen and scientists alike. We all knew that when each dredge arrived on deck we would have a fresh part of Loihi, never seen before. Then the first equipment malfunction occurred. The shore party had problems with the radio navigation beacons and no signals were received by the ship. Finally, signals were acquired from one beacon, and the chief scientist was satisfied that this range data, coupled with the detailed bathymetric map prepared from our 1978 cruise, would permit accurate location. The first dredge was lowered from the ship's fantail and sank to about 5,000 feet on the north



A Landsat satellite view of the island of Hawaii and its volcanoes. Loihi, the underwater volcano that may someday rise to become the newest island in the Hawaiian chain, is located thirty miles to the southeast.
USGS, Flagstaff

rift zone. When it arrived back on deck two hours later, it was filled with fragments of very young, dense lavas. Many fragments had fresh glassy rims, suggesting maximum ages of only a few hundred years.

The contents of the third dredge were a surprise. Some of the lava samples had many vesicles, or open bubbles, formed by expanding gases when the lava was still molten. Such frothy lava is rare at submarine volcanic vents because the great pressure (150 atmospheres at 5,000-foot depth) compresses gas. These lavas were exceptionally rich in gas, quite unlike other Hawaiian submarine lava. We were also surprised by the discovery of angular fragments of dense, coarsely crystalline rock that were abundant in some lava samples. They were carried up in the melt from deep inside the earth; again, these crystalline fragments are virtually unknown in tholeiitic basalt but are fairly common in alkalic basalt. The lavas of Loihi were a strange, mixed bag that simply did not fit our preconceived notions. We were finding old-age lavas on an adolescent volcano. The dredging continued around the clock for three days. Seventeen dredges later we had recovered four tons of rock from Loihi. As the ship steamed back to Honolulu, we assessed the accomplishments of the cruise. We had confirmed that Loihi was a very young volcano, we had recovered more samples of reddish brown hydrothermal deposits near its summit, and we had discovered that Loihi ejected lavas very different from the youngest lavas known from any other Hawaiian volcano.

Laboratory analysis indicated that the Loihi samples were nearly all less than 4,000 years old and many less than 1,000 years old. The alkalic basalts were generally older than the tholeiitic ones but there was considerable overlap. Generally, the most recent volcanic activity had occurred on the summit and the south rift, while the north rift had the oldest lavas.

Research now focuses on questions raised by the Loihi lavas: How can such a young volcano nearly simultaneously eject lavas of such widely varying composition? What kind of a plumbing system keeps these melts separate as they rise to the eruption vents? Does mixing of magmas take place? Why are the alkalic lavas richer in gas than the tholeiitic lavas, and why are they the only lavas that contain dense crystalline rock fragments?

These questions lead to even more fundamental problems. How are the two lava types generated at a single hot spot and what is their significance in the life history of oceanic volcanoes? What do they tell us about the processes occurring deep in the earth where magmas are produced?

The data currently available point to a revised model of Hawaii hot spot volcanism, as follows. The hot spot, a great heat engine, waxes and wanes in intensity as lavas fed from it build individual volcanoes. During the early stages exemplified by Loihi, as the engine accelerates it heats the overlying cool lithosphere that has rafted over it from the southeast. The first melting is deep and widely dispersed and involves only the constituents with the lowest melting points and the volatile elements. The isolated pockets of this original, gas-rich melt finally merge, seek out a conduit, and erupt on the ocean floor as small volumes of alkalic lava. As the melt moves upward, gases expand, flow accelerates, and the melt is able to rip off fragments of dense rock and carry them to the surface.

Later, as heating continues, the volcano enters the second stage exemplified by Mauna Loa. A massive amount of melting takes place. A higher proportion of the rock is melted so that those constituents with lower melting temperatures—the alkalis and volatiles—are diluted by the hotter melting constituents. Large volumes of tholeiitic basalt are frequently erupted, building the bulk of the volcano, which rises above sea level.

Finally, as plate motion carries the volcano and its deep plumbing away from the hot spot, old age ensues. Enough heat from the hot spot is available for only small amounts of melting, and only constituents with lower melting temperatures can melt. During a long period of waning activity, small amounts of alkalic lava are ejected and the volcano eventually dies.

A final question is, When will Loihi erupt again? We do not now know, but if plate motion and hot spot activity continue at their present rates, Loihi should rise above sea level in a few tens of thousands of years and might grow to the size of Mauna Loa in a few hundred thousand years. In addition, as Loihi continues growing, new rumblings on the sea floor may be signaling the birth of yet another submarine volcano to the southeast. ☐

Maupintour's Hawaii Deluxe

ENJOY BEAUTIFUL LIVING on an escorted tour that perfectly balances scheduled activities and leisure time. Feel younger than springtime!

TWO DELUXE HOLIDAYS: 3 islands, 9 days or 4 islands, 13 days. Relaxed sightseeing, a la carte dining, local happenings, special events, entertainments...all included. Orchids, Polynesian Center, whaling tours, volcanoes, waterfalls, luaus, pineapples, helicopter flightseeing, sleepy lagoons, hidden beaches, palms, paradise.

WHAT YOU DREAM Hawaii should be, including the fun of traveling with congenial companions and the luxury of fine rooms in the most desired resorts.

SEND THIS COUPON to Maupintour for the free brochures checked or ask your favorite Travel Agent.

☐ Alaska ☐ Africa ☐ Canada ☐ India
☐ Europe ☐ California ☐ USA East
☐ Colorado ☐ Arizona ☐ Hawaii Deluxe
☐ British Isles ☐ Christmas ☐ Festivals
☐ South Pacific ☐ Middle East/Egypt
☐ Fall Foliage ☐ Spain ☐ Circle Pacific
☐ USA West ☐ Scandinavia ☐ Greece
☐ Orient ☐ Central Asia ☐ China

USTOA United States Tour Operators Association
Maupintour
quality escorted tours since 1951

P.O. Box 807, Lawrence, Ks. 66044
Telephone toll-free 800-255-4266.

name

address

city

state/zip

my travel agent nhs-haw-3

A Cloudy Future

A postscript by Hampton L. Carson

Hawaii's biological treasures face many threats. Introduced diseases and predators, forest clearing for logging and pasture, and the displacement of native biota by introduced plants and animals are taking a devastating toll.

Evolving as they did in splendid isolation from herbivores, the Hawaiian plants do not have protective spines or poisonous leaves. When goats, pigs, cattle, and deer were introduced, they quickly produced wild populations that continue to seriously degrade the native forests. Land-management practices by the state and by large landowners tend to treat the Hawaiian forests as insignificant or undesirable. Great tracts of native forest have been replaced with eucalyptus and other exotic trees in the mistaken notion that they would produce better timber resources. Such plantings did not prove economically sound, and the damage to the delicate native ecosystems, especially in the lowland areas, is virtually beyond repair.

Even more damaging was the clearing, long ago, of lowland areas for the planting of sugar cane and pineapple. More recently, residential subdivisions have spread up the slopes to the very edge of the rain forests. Large cattle ranches, which sprawl over the drier areas of both the uplands and the lowlands, are continually expanding into the higher and wetter forests.

Energy needs in the 1980s have generated new threats to natural areas, especially to the rain and cloud forests that are still not deeply penetrated by agriculture. For example, a large private landowner and a mainland consortium have proposed to locate thirty-five geothermal wells just outside the boundary of Hawaii Volcanoes National Park on the island of Hawaii. Development of the selected sites would require forest clearance and the building of roads into the one great area of intact rain forest remaining on the windward slope of the island. One does not have to be opposed to all geothermal development to insist that this forest be preserved.

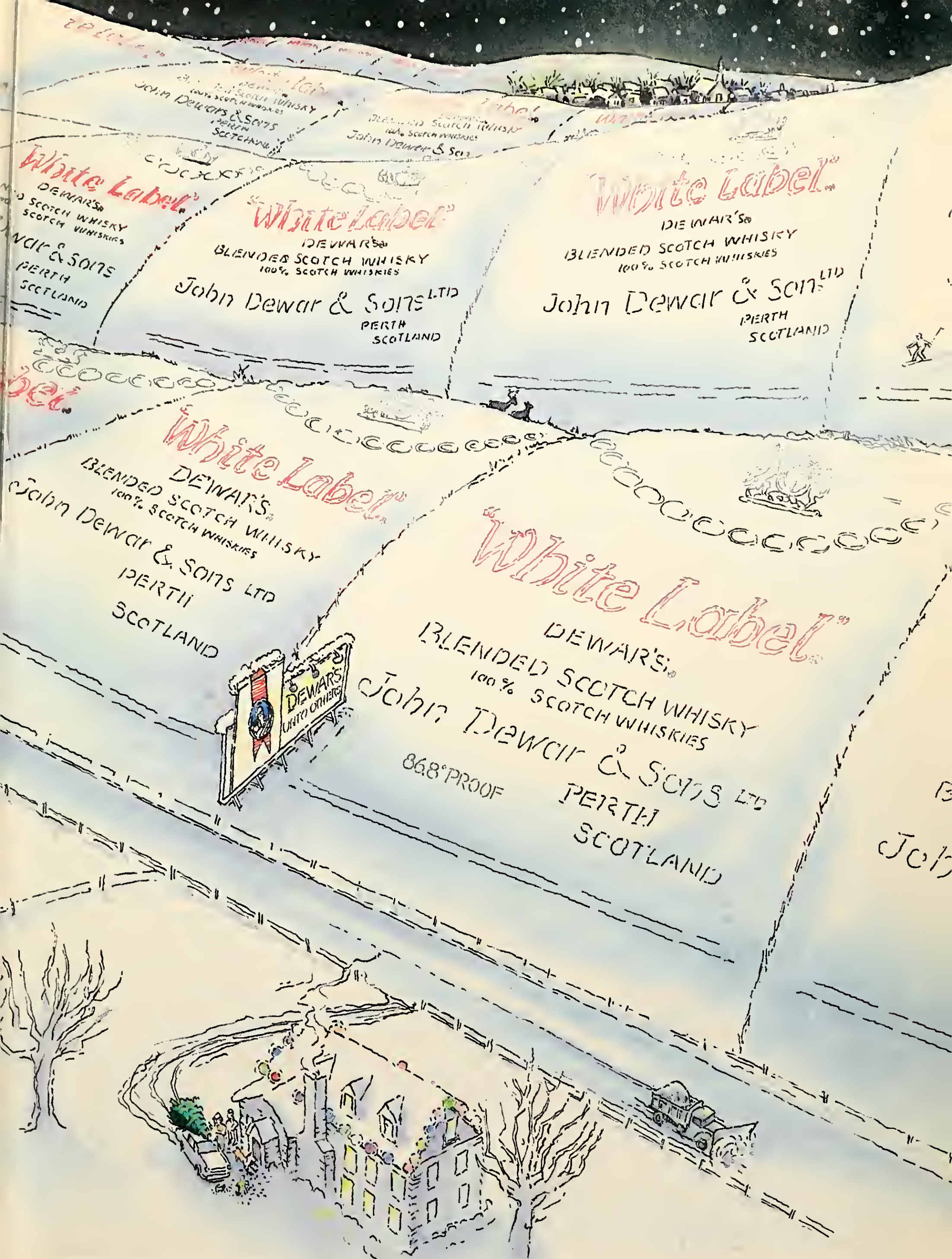
Biologists in the federal government and state agencies in California, far from the ridges and rain forests of Hawaii and insensitive to the native biological scene, state that the Mediterranean fruit fly, which arrived about seventy-five years ago and occurs all over the islands, can be exterminated from Hawaii. They propose to blanket the islands with malathion-laced baits. This scheme cannot possibly succeed, but would surely do grievous damage to the environment.

This catalog of actual and potential threats to Hawaii's ecosystems is not a pretty one. It owes its worst details to attitudes inherited from colonial and territorial days and to the continued dominance of developers in island affairs. The forest and its life forms are considered an economic liability. In the schools, children have traditionally been taught about continental biology—squirrels and pine trees—instead of about Hawaii's honeycreepers and silverswords.

There are, however, hopeful signs that attitudes are changing under the influence of a new generation of biologists and teachers. One sign is the recent activation of the Conservation Council for Hawaii, which is working to make residents aware of the richness of Hawaii's natural history and to arouse the interest of state, national, and international conservation groups.

The problems are unlike those of conservation on the continents. Hawaii's animals and plants are closely tied to special and vulnerable environments. Since these change with the age of the volcanoes and the weathering of the lava flows, almost every valley and ridge of every island shelters some unique form of life. Conservation efforts cannot succeed if they are concentrated in a few large preserves or national parks. Hawaii has a mosaic of habitats that can be preserved only by maintaining a series of natural areas on each island. An encouraging example is provided by recent purchases of critical habitats by the Nature Conservancy. The Hawaii Natural Areas Commission has also shown interest; a few tracts of land have been set aside and more are planned.

Realization of the special character of the Hawaiian life forms has been late in coming. Fortunately, Hawaii's conservation needs have at last been eloquently articulated by many scientists and citizens. Strong action cannot be far behind. ☐


"White Label"
DEWAR'S
BLENDED SCOTCH WHISKY
100% SCOTCH WHISKIES
John Dewar & Sons LTD
86.8° PROOF
PERTH
SCOTLAND
DEWAR'S
UNTO OTHERS

BLENDED SCOTCH WHISKY • 86 8 PROOF • © 1982 SCHENLEY IMPORTS CO., N.Y., N.Y.

Fall from Space

A satellite orbiting the earth at an altitude of almost 4,000 miles is falling much faster than anticipated

by Stephen P. Maran

Many discoveries have come from instruments and telescopes aboard orbiting satellites. But some findings gleaned from satellites do not depend on observations made from the spacecraft themselves. Rather they come from simply tracking the satellites as they revolve around the earth. A case in point is Lageos, an artificial earth satellite that, although a precision product of high technology, contains no instruments, operating mechanisms, batteries, solar cells, electrical circuits, or communications gear.

Lageos (an acronym for Laser Geodynamic Satellite) was launched in May 1976 into an orbit in a relatively unexplored part of the earth's space environment. It circles the earth in a nearly polar orbit at an altitude of about 3,700 miles, far above the altitudes of only a few hundred miles where most satellites that gather astronomical and atmospheric data fly, and far below the numerous communications and weather satellites stationed in geosynchronous orbit at an altitude of about 22,000 miles. Lageos's mission is to enable us to monitor the motions of the earth's tectonic plates with respect to each other—that is, to measure continental drift. Lageos's orbit has been determined with great accuracy. Ground observers track the satellite with lasers and telescopes, not to learn where it is (which is why most satellites are tracked), but to learn exactly where their tracking stations are from day to day and year to year in relation to the earth's coordinates. The observations of Lageos from earth thus permit calculations of the speed and direction of the drifting continents.

Lageos is performing its mission well, but the data from tracking stations reveal an unexpected phenomenon. They show that a force of uncertain nature is acting on the satellite, causing it to fall toward the earth at a greater rate than was anticipated. The fall, in any case, is extremely slow, amounting to a current drop of just about 1/25 of an inch per day. This drop poses no threat because Lageos won't reach the ground for at least 500,000 years and may well remain in orbit for a few million years. Although hundreds of satellites have been tracked since the launch of the first *Sputnik* in 1957 and many have fallen from low orbits (most disintegrated in the earth's lower atmosphere as they fell), the fall rate of Lageos may be the slowest yet measured. (Satellites in higher orbits than this one presumably fall at even slower rates, and their drop cannot even be detected by current means.) The unexpectedly high rate of fall of Lageos is due to a force of some kind. The question is, What is it?

Some satellites have safely reentered the earth's lower atmosphere by means of retrorockets, others have burned up on reentry, and still others—such as the ill-fated Skylab, parts of which fell on Australia in July 1979, and the nuclear-powered Soviet spacecraft Cosmos 954, which smashed into the northern Canadian wilderness in January 1978—have simply crashed. Except for the spacecraft powered by retrorockets, these satellites were brought down by a force called atmospheric drag—the resistance of the thin upper atmosphere to the motion of a spacecraft. Is atmospheric drag responsible for Lageos's drop rate?

The atmospheric drag on a satellite depends on several factors. One is the surface area a satellite presents in the forward direction. The greater that area, the greater the resistance of the atmosphere. Accordingly, a satellite shaped like a bullet would suffer more drag when its side faces forward than when its nose points straight ahead. Drag also depends on altitude. Since the air is thinner at higher altitudes, the higher a given satellite may be, the less drag it suffers. Finally, drag depends on the mass of the satellite; heavier craft are less affected than lighter ones of the same size and shape.

To make it very massive—and thus less subject to atmospheric drag—Lageos was built around a 386-pound cylindrical hunk of brass. Its exterior surface is a two-foot aluminum sphere, studded with 426 mirror devices that reflect laser light from tracking stations. No matter which part of Lageos faces forward, the spacecraft always presents the same amount of surface area to the resistant atmosphere. Given all of the above and knowing the satellite's altitude, the atmospheric drag on Lageos can be calculated easily and the rate at which it should be coming down can be estimated. This has been done independently by scientists in the United States and France with similar results: the calculated drop rate is roughly ten times slower—about 1/250 inch per day—than the actual measured drop rate. Therefore, these scientists have rejected the proposition that atmospheric drag is the mysterious force bringing Lageos down.

Gravity, of course, is the force that keeps a satellite in orbit around the earth. But the earth is not perfectly round, nor is the distribution of mass within it entirely homogeneous. Thus, as a satellite passes over different parts of the planet, there are differences in the force of gravity even at the same altitude. The earth is flattened at the poles (as geographers first suspected in the late seventeenth century); its diameter is greater at the equator than through the poles. In addition, the earth is slightly pear shaped, with the North Pole—where the "stalk of the pear" would be—somewhat farther from the center than the South Pole. The pear shape was discov-

GIVE NATURAL HISTORY

This Holiday Season give one gift at $15
and save 20% on subsequent gifts at $12 each

☐ YES, send ______ gifts, which include 12 thought-provoking issues of Natural History and all the benefits of a one-year Associate Membership in the American Museum of Natural History.

GIFT TO:

Name ____________________

Address ____________________

City ____________________

State ____________ Zip ________

GIFT TO:

Name ____________________

Address ____________________

City ____________________

State ____________ Zip ________

Mail this Postage-paid card Today!

GIFT FROM: J569

Name ____________________

Address ____________________

City ____________________

State ____________ Zip ________

☐ Payment enclosed ☐ Bill me

Charge my ☐ Visa ☐ Mastercharge
☐ American Express

Account number ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Signature ____________________

☐ 1 Gift at $15 $15
☐ Additional Gifts at $12 ________
(20% savings)
Total Enclosed $ ________

Outside U.S.A. please add $5 for postage

Monayback guarantee if not satisfied

Special Money Saving Gift offer!

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 30 BERGENFIELD, N J

POSTAGE WILL BE PAID BY ADDRESSEE

NATURAL HISTORY
P.O. Box 4200
Bergenfield, N.J. 07621

Give
NATURAL
HISTORY
at Special
Holiday
Rates!
NATURAL HISTORY
4/81

This holiday season give the **distinctive gift** that is inexpensive and easy to give. **Natural History** is the perfect holiday gift that keeps giving all year long.

It's inexpensive—only $15 for your first gift
It saves you money—only $12 for each additional gift
It's easy—Use the postage paid cards in the magazine or call the toll-free number listed below.

Your gift recipient(s) will receive a valuable membership card that entitles him or her to all the benefits listed on the right. You'll be able to announce each gift with an attractive gift card we will send you as soon as we receive your order.

Give the gift of Natural History and membership in the American Museum today!

Your Gift brings all these Benefits:

- A one year subscription to Natural History (12 issues)
- Free admission to the American Museum of Natural History
- Access to the air-conditioned Members' Lounge
- Travel opportunities led by Museum scientists to all parts of the world.
- Discounts on artwork, books, crafts, jewelry, and other gift items from our Museum shop
- Admission to special features and programs
- A valuable membership card
- Free ticket to our NatureMax Theatre

To Order: CALL TOLL FREE 800-247-5470
(In Iowa) 800-532-1272

Or Write: Natural History Magazine
Membership Services
Box 4300
Bergenfield, N.J. 07621

AMERICAN MUSEUM OF NATURAL HISTORY

ered in 1958 from tracking data on the tiny American satellite Vanguard 1. Because of the earth's pearlike shape, the change in the gravitational force exerted on the 3½ pound Vanguard 1 as it revolved around the planet caused the low point, or perigee, of Vanguard's elliptical orbit to drop by a few miles, then rise up, only to drop again, oscillating over and over every eighty-two days.

One possible explanation for Lageos's faster-than-expected drop rate is that it is due to the slight irregularities in the distribution of mass within the earth. Such an effect, called a gravitational resonance, should produce an oscillating motion in Lageos similar to the much greater effect of the earth's pear shape on Vanguard 1, but not necessarily with the same eighty-two-day period. In other words, if the observed drop is due to a gravitational resonance, it should taper off and then Lageos should rise again. In the more than six years since its 1976 launch, however, Lageos has shown no sign of an upward drift. In fact, as David P. Rubincam, a geophysicist at the Goddard Space Flight Center in Greenbelt, Maryland, recently told me, there was a period from late 1978 through late 1979 when the satellite's drop rate was about 60 percent greater than the steady 1/25 of an inch per day fall observed both before and after that period. Rubincam, who has completed the most exhaustive analysis of the Lageos drop rate that I have seen, has therefore rejected the possibility that a gravitational resonance is responsible for the observed rate.

Since we don't know what is making Lageos fall, one option is to analyze the tracking data and thereby deduce the properties of the unknown force. This was attempted by Victor Szebelehy, an engineering professor at the University of Texas in Austin who is an expert on celestial mechanics—the study of the motions of objects in space. In June 1980, at a space research meeting in Budapest, he reported that he had succeeded in calculating how the force acting on Lageos varies with the satellite's position in space. Unfortunately, since the resultant information could not be related to any particular known physical force, it did not solve the puzzle.

In 1981, Rubincam reported on his investigation of ten kinds of physical processes that could affect the motion of Lageos. Among these were the two already mentioned—atmospheric drag and gravitational resonance—and several esoteric radiation phenomena that involve the way in which light falls on the satellite and heats it, causing the spacecraft to release infrared radiation. Such radiation is emitted more strongly in some directions than others. Each of these radiation phenomena can have some slight influence on the motion of a satellite, but none appears to be a likely cause of the fall of Lageos. Rubincam evaluated the pressure exerted on Lageos by light from the earth—which consists both of sunlight reflected from the ground, oceans, and clouds, and of infrared radiation emitted from the surface of the earth—and found it wanting. Also rejected on the basis of calculations were the effect of the earth's magnetic field and drag by interplanetary dust particles (fragments from the breakup of comets).

Rubincam concluded that the most likely cause for the fall rate of Lageos is a force called plasma drag. This conclusion agrees with a 1980 study by four physicists at the Center for Geodynamical and Astronomical Study and Research in Grasse, France. (The French group, however, had not considered many of the alternatives.) Plasma drag is a resisting force that occurs when an electrically charged satellite passes through a region where electrified particles (plasma) are present.

Because of collisions with electrons, the surfaces of orbiting satellites often become electrically charged and develop measurable voltages. These voltages

Questers for 1983

Travel with a purpose. Learn and discover. Search out plants and animals, birds and flowers. Explore rain forests, mountains and tundra, seashores, lakes and swamps. With Questers you will have ample time to photograph, absorb and reflect. Naturalist guides, small tour parties, first-class accommodations.

Worldwide Nature Tours
1983 Departures

The Americas

Okefenokee Swamp: 12 days, 4/17 • Everglades: 11 days, 4/7, 11/3 • Hawaii: 15 days, 2/10, 3/24, 10/20, 12/22 • Alaska: 17 days, 6/24, 7/12 & 30 • Pacific Northwest: 12 days, 6/20, 8/8 • Superior Forest Canoe Trip: 9 days, 7/9, 8/13 • Canyonlands: 11 days, 5/6, 10/7 • Northwest Canada: 16 days, 7/1 • Manitoba (Churchill): 12 days, 6/20 • Newfoundland: 16 days, 6/12 • Southern Mexico: 14 days, 2/13, 12/18 • Panama & Costa Rica: 14 days, 2/14, 3/21, 12/19 • The Amazon: 17 days, 1/9, 5/8, 7/3 & 31, 10/2, 11/13 • Ecuador & Galapagos: 16 days, 2/9, 4/13, 7/6 & 27, 10/19, 12/21 • Peru: 17 days, 7/17, 11/6 • Patagonia: 22 days, 1/10, 11/7 • Trinidad & Tobago: 11 days, 3/7 & 21, 11/7 & 21.

Europe

Iceland: 16 days, 6/17, 7/8, 8/5 • Islands/Highlands of Scotland: 21 days, 6/2, 7/14 • Switzerland: 17 days, 7/15, 8/12 • Greece: 19 days, 3/28, 9/19 • Spain: 20 days, 4/15, 9/16.

Asia and Africa

Japan: 23 days, 6/3 • Sri Lanka: 18 days, 2/18, 11/18 • Walking in Foothills of Western Himalayas: 19 days, 4/14 • Himalayas: Nepal, Sikkim & Bhutan: 23 days, 3/17, 10/6 • Kenya: 23 days, 2/3, 7/21, 10/20 • Zimbabwe & Botswana: 19 days, 5/26, 7/7, 10/13.

Oceania and Australasia

Australia & New Zealand: 28 days, 2/12, 10/1 • New Zealand & the Milford Track: 22 days, 2/11, 11/11 • Papua New Guinea: 22 days, 5/20, 8/5, 11/4

Write for the 1983 Questers Directory of Worldwide Nature Tours. If a particular tour strikes your fancy, ask for its Detailed Itinerary.

QUESTERS
Questers Tours & Travel, Inc.
Dept. NH, 257 Park Avenue South
New York, NY 10010 • (212) 673-3120

Treasures From The Earth

Color Portfolio of Natural Specimens and Catalog of Minerals, Display Stands, Books and Natural Jewelry, $3.00

Dover Scientific
Box 6011C Long Island City, NY 11106

For the sixth year, we invite adventurous travelers to join our carefully surveyed foray to remote Indonesia

River Safari in Borneo

with visits to archaeological and historic sites in Java and the lovely island of Bali

SEPTEMBER 9 TO 28, 1983

Five days are spent touring Java, including a train journey to the Borobudur, the world's greatest religious monument, which we see at sunrise

We then fly to Borneo, to cruise for one week on the Mahakam river and its tributaries, striking deep into the Dayak country with its remarkable wildlife, where we attend village ceremonies and sleep one night in a native longhouse. The tour ends with two days of well-earned comforts on the island of Bali, and is escorted by our accomplished leader

Detailed brochures are available from.

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

range from less than the 1.5-volt rating of a standard flashlight battery to about 20,000 volts. Ordinary atmospheric drag is caused by the impact of atoms and molecules on the surface of a satellite, so that only those particles that actually strike the satellite contribute to the drag force. However, since electrical force acts at a distance (as do gravity and magnetism) rather than only on contact, plasma drag is exerted both by the electrified particles that strike a satellite and by the much greater number of particles that happen to be in the satellite's general vicinity. In the case of Lageos, plasma drag might be caused by protons and positively charged helium and oxygen atoms that are deflected by electrical force when they come near the satellite. Lageos, like various earlier satellites, is presumed to bear an electrical charge. Since every action has an equal and opposite reaction, the deflection of the plasma particles would produce a force on Lageos. Plasma drag on Lageos should act just like atmospheric drag but is calculated to be stronger—strong enough to produce the observed fall rate of 1/25 of an inch per day, given a plausible estimate of the voltage on the surface of Lageos (about 1.5 volts).

At this writing, plasma drag is the leading candidate for the force that is dragging Lageos down. The case is not closed, however. To begin with, we don't have an actual measurement of the voltage on Lageos, since there are no instruments aboard the orbiting craft, and the estimated voltage could be wrong. Although they look promising, the plasma drag calculations need to be confirmed. Atmospheric drag on Lageos may also have been underestimated, because it was calculated from measurements of the atmosphere made at much lower altitudes than that of the falling satellite. Also, the atmospheric drag calculations are based on the simplifying assumption that the atmosphere at the altitude of Lageos is almost pure hydrogen, but (as Rubincam has suggested, although others disagree) much helium may be present. Helium is a heavier gas than hydrogen and would produce more drag. Direct measurements of atmospheric density and composition at the altitude of Lageos are therefore needed, and until they are available, atmospheric drag remains a positive alternative to plasma drag as the force responsible for the satellite's fall from space.

Stephen P. Maran is a senior staff scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland. The views expressed here are his own and do not necessarily represent those of NASA.

Share the Thrills of Exploring Outer Space!

$359.95 f.o.b. Hartford, Conn.

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

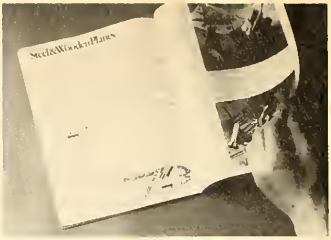
FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

Criterion Manufacturing Co.
620 Oakwood Ave., W Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION. MANUFACTURING CO., Dept NH121
620 Oakwood Avenue, W. Hartford, Conn. 06110
Please send your free Telescope Guide.
Name________
Address________
City________State________



Turning into a better craftsman can be as simple as turning the pages of our new catalog.

Our new 244 page catalog is filled not just with pictures of great hand and power tools, but carefully written specs, detailed illustrations and recommendations from craftsmen who've spent much of their lives making, using and testing tools.

You'll know what they look and feel like, and you'll know how they fit your needs.

We believe you're not the average craftsman. So why should we give you an average catalog?

Garrett Wade Co., Dept. 100
161 Ave. of Americas, N.Y., N.Y. 10013
Please send me your 244 page catalog of wood working tools, machinery and accessories. Enclosed $3.00.
Name________
Address________
City________
State________Zip________

The answer to the Chinese puzzle.

If you're confused about how to choose a China tour our 32-page brochure is the answer. It's proof positive that no one knows China better than Princess Tours.

So see your travel agent or send this coupon to: Princess Tours, Brochure Distribution Center, 3322 La Cienega Place, Los Angeles, CA 90016.

CHINA
PRINCESS TOURS

Princess Tours/China
The Vacation Company

C3DTL

THE MARKET

Art

AMERICAN INDIAN CRAFTS: Southwest Indian pottery, baskets, rugs, kachinas. Northwest Coast Indian masks, totems, graphics, Eskimo sculpture. Recent African bronzes. No catalogue. One-of-a-kind pieces, individually photographed. Priced $100/up. Photos and data available. Specify interests. Box 5896, Sherman Oaks, CA 91413. (213) 789-2559

COSTA RICAN Folk and Indian arts, individually photographed. Specify interest. Box 979-1002. San Jose, Costa Rica

FEDERAL/STATE WATERFOWL STAMP PRINT Specialists. Excellent inventory. Write or call (503) 343-9255 for informative newsletter. d'Lou Wildlife Galleries, 2769 Emerald, Eugene, OR 97403

FLORIDA'S ECOSYSTEMS: Six spectacular color prints by Pat Elliott. Send $6.95 per set to: Florida Wildcountry, Box 987, Gainesville, FL 32601

INDIAN AGATE BEADS, illustrated history by Peter Francis. $8.00. Cornerless Cube, Riverside Drive, Lake Placid, NY 12946

ISOAXIS: Inventive construction toy for children/adults. Rotational into five different star polyhedrons. Printed 30 colors, made in Switzerland. $3.00 each. $24.00 Dozen. Order from Wallace Walker, 41 West 46th, New York, NY 10036

MASKS FROM NEW GUINEA, $95 and up, request photos and information. McCoy Imports, Liberty, NY 12754

OLD JAPANESE CALLIGRAPHY from wood block books and handmade paper made into stunning, framed collages. 5×7 $20, 8×10 $30 plus $2.50 p.h. U.S. R. Via, 1001 Lunaai Pl., Kailua, HI 96734

PLAINS INDIAN ART & ARTIFACTS: Free catalogue shows painted shields, mounted trophy buffalo skulls, war arrows, peace pipes, chokers, breast plates, war clubs, horse dance sticks, star quilts and more. Exclusive source. Handmade with traditional tools and authentic materials. Many have interesting stories to tell from Cheyenne, Sioux and Blackfoot heritage. Collector's items, unique gifts and stunning decorations. Write or call: Prairie Edge, P.O. Box 8303, Dept. K, Rapid City, South Dakota 57701 (605) 341-3620

PRIMITIVE ARTIFACTS/CARVINGS. Handmade carvings, artifacts, tapa cloth, museum reproductions, Gods, etc. $22 to $3900, 10" to 7' tall. Send $5 for full color catalogue to Griffs Graven Images, P.O. Box 345158, Farmers Branch, TX 75234

SOUTH SEAS FOLK ART—Unique hand-carved animals from Bali and Java. Color catalogue $1 (refundable). Eastern Arts, 365 Bleecker Street, New York, NY 10014

Back Numbers

NATIONAL GEOGRAPHICS 1888-1982, issues Book Publications, Collectors Items, Send Wants Buxbaum Geographics, Box 465-NH, Wilmington, DE 19899

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHX, 84 Fifth Avenue, New York, NY 10011

Books

BIRD BOOKS, other natural history. Rare, Out-of-Print, Color Plate. Catalogue of 1,100 books—$2.00. Books bought. Larry J. Rusecki, Blue Ridge Rd., Schroon Lake, NY 12870.

BOOKFINDING LIBRARIANS locate any subject or title, 150,000 different titles in stock, indexed by author, subject & title. "PAB", 2918 Atlantic Avenue, Atlantic City NJ 08401 or (609) 344-1943

DISCOUNT BOOKS—Richard Leakey's "Making of Mankind" (list $24.95) only $12.98. Most new books available at 20% off. Free brochure. Add $1.25/title shipping (plus 5% in MD). Earthworks/NH, 8135 Ball Rd., Frederick, MD 21701

ECOLOGY OF STONY CREEK QUARRY PRESERVE. Maps, photos. $10.83. Quarry, 107 Montowese St., Branford, CT 06405

FREE BOOK SEARCH. Also Nature book lists. Write: Smith's Book Service, Rt. 6A, Brewster, MA 02631

LITERATURE ON CASSETTES. 1500 titles: Books, Poetry, Children's, more! Free catalogue: Literature, Box 626-J, Port Hadlock, WA 98339

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalogue: Hamilton's, 98-55 Clapboard, Danbury, CT 06810

Camps

PRAIRIE TREK AND TURQUOISE TRAIL Expeditions (Boys 10-17, Girls 13-17). Since 1926 the Expeditions have made it possible for young people to explore in the mountains, canyons, and desert country of the American Southwest. Emphasis on environmental studies, archaeology, native crafts, backpacking and camping skills. For details write Thomas Billings, P.O. Box 40451NH, Indianapolis, IN 46240 (317) 896-3842

Collectors Items

COLLECT AMERICAN MUSEUM of Natural History Stamps. All genuine—mint or used U.S. Postal Issues. Also: Botanical, Wildlife Conservation, National Parks and many others. Send $3.00 (check or money order) to begin subscription series. Satisfaction Guaranteed Cancel at any time. The Collector's Choice, Ltd P.O. Box 777, Nyack, NY 10960

RECEIVE VALUABLE MINERALS MONTHLY! Free Details! Write Today! Mineral of the Month Club, 13057-HA California, Yucaipa, CA. 92399

Correspondence

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin, West Germany

PENFRIENDS-ENGLAND-USA. Make lasting friendships through correspondence. Send age, interests. Free reply Harmony, Box 89NH, Brooklyn, NY 11235

SCANDINAVIAN LADIES, sincere, seek correspondence for meaningful relationships. Details: Scannaclub, Dept. H6, Box 4, Pittsford, NY 14534

SINGLE BOOKLOVERS gets cultured persons acquainted. Nationwide. Established 1970. Write Box AE, Swarthmore, PA 19081 or call (215) 566-2132

VITAL, ATTRACTIVE WOMAN seeks correspondence with reasonably mature gentleman who has a sense of humor, and is interested in sailing P.O. Box 759, Cooper Station, NY 10276

Education

LEARN/PLAY CHESS with more flair . . with Color/Coded Pieces (patented). Send SASE for poster/info: Iris, P.O. Box 262, Newbury, Ohio 44065

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Big Pay! Transportation! Newest Handbook, $2.00 Australian International, Box 19107-RZ, Washington, DC 20036

ENVIRONMENTAL OPPORTUNITIES—Monthly bulletin lists environmental job openings throughout the U.S. Free details: EOV, P.O. Box 450, Walpole, NH 03608

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RZ, Washington, DC 20036

OVERSEAS JOB—68 COUNTRIES! Hiring now! Paid fare. Computerized reports $2.00. Jobworld, Box 681-NH, Cypress, CA 90630

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . Intermountain 4Y, 3506 Birch, Cheyenne, WY 82001

TEACH HERE—TEACH ABROAD: School, College openings; USA $5.95; Abroad $5.95. China, Japan, Saudi, Australia $5.95 each. EISF, Box 662, Newton, Massachusetts 02162

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Gibraltar. Sampler: 4/$2.98. Free Brochure. Multinewspapers, Box DE-20B, Dana Point, California 92629

Gourmet Interests

AUTHENTIC WEST INDIAN AND AFRICAN Cookbooks. Delicious and easy. $4.00 each. Mozia, 970 Soldier hill Road, Emerson, NJ 07630

CHICKEN CURRY, authentic Indian recipe $1 SASE: Box 4403, San Rafael, CA 94913

MAPLE SYRUP direct from Vermont farm. Packaged varieties from gift-jars boxed in wood to five gallon tins. For pamphlet send 50¢ to New Morning Farm, Bethel, Vermont 05032

MINNESOTA WILD RICE. $6.00 per pound, prepaid. Five pound minimum. Floura Bros, Box 44C, Blackduck, MN 56630

Government Surplus

"GOVERNMENT SURPLUS DIRECTORY." 950,000 items (including Jeeps) . . . low as 1¢ on dollar! Most complete information available—$2.00. Disposal, Box 19107-RZ, Washington, DC 20036

Merchandise/Gifts

AFRICAN—AMERICAN INDIAN Relics-Carvings-Baskets-Weapons-Curios. Catalogue $1.00. Thompson-Simon International, 9810 Hillhaven, Dept. NH, Tujunga, CA 91042

ATTRACT SONGBIRDS with the Audubon Bird Call. Handmade of pewter and birchwood, easy to use, really works! Send $5.50 to Kerry Rasp, 655 East Passaic Ave., Bloomfield, NJ 07003

BE DIFFERENT this gift giving season. Send for free color brochure. Louisiana Gift Pack, P.O. Box 2015, Covington, Louisiana 70434

BEESWAX CANDLES. Hand-dipped direct from beekeeper. Prices, free gift card Send SASE, Box 564, Creswell, Oregon 97426

DOG TAGS FOR YOUR BAGS, cameras, equipment, etc. 4 lines—15 spaces each, 3 tags $11.99. NYS add tax. CMA, 1742 Second Ave., Dept. 200P, NYC 10028. Free brochure #P, (212) 249-1381

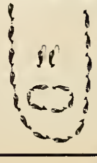
EGYPTIAN SCARABS. Ancient symbol of good luck and immortality. Hand-carved in Egypt. Mounted on beautiful 18" 12K goldfilled chain. Great gifts! Send $6.95 or save and order 2 for $12.95. Includes giftbox. Waterbabies, Dept. SNH-12, Suite 41, 2067 Broadway, NYC 10023

FREE CRYSTAL CATALOGUE. Sparkling pendants, earrings, window prisms crafted from 32% full lead crystal. Free shipping. Give a rainbow for the holidays! For free catalogue, send 20¢ stamp: Waterbabies Crystal, NH-12, Suite 41, 2067 Broadway, NYC 10023

FREE, two all purpose greeting cards, spectacular floral prints, with set of 10 cards, envelopes, moneyback guarantee, send $5.95 plus .85 postage to Willow Branch Cards, 8223 N. Lake Dr., Milwaukee, WI 53217

HAND CARVED MAHOGANY, Mayan design bowls, plaques, owls, boxes, office items, tables, free brochure. Artisan Originals, Rt. 1, Box C-24, Flat Rock, AL 35966

"I LIKE IT WILD™ . . . " Wilderness/wildlife posters, T-shirts, notecards. SASE: Wilderness Dreams, Box 4455-N, Shawnee Mission, KS 66204



Sterling silver **Whale Set** $55 or
Separately: Pierced Earrings $11
Link Bracelet $18
18" Chain $30
Anne Dick Jewelry, P.O. Box 459,
Pt. Reyes Station, CA 94956.
Add $1.50 for complete catalog
of 500 designs.

NATURE'S NOTECARDS. Four original color photos—wildflowers, spiderwebs or reflections, $4/set. Nature/N, 2128 Stonyvale, Tujunga, CA 91042

ONYX GEOMETRICAL FIGURES. Sphere, Cube, etc. Approximately 2". Three for $10.00 plus $2.00 handling, postage. Send check, money order Geonyx, Dept NH-12, C/O Box 5066, El Paso, TX 79953

SCIENCE/NATURE CLUB FOR CHILDREN. Explore wonders of nature/science! Full year's membership includes bimonthly 8-page newsletter, at-home experiments, discounts on science books, official membership badge and more! Year round activities and learning that's fun. Give a gift that grows with a child. Ages 7-10. Send $20.00 plus child's name, address, age to: The Universe Club, Dept. NH-12, 23 West 89th Street, Suite 4R, NYC 10024

THE FLYING EAGLE: Finest laser color reproductions of the ultimate Bald Eagle photograph. 12" × 20", $15. Beautiful Eagle Christmas and greeting cards, 10 for $6, 50 for $25. Dr. Hunter, Box 10-888, Anchorage, Alaska 99511

TRAVEL SECURITY DEVICE—smoke, fire, intruders. Free brochure #N, (212) 249-1381. CMA, 1742 Second Ave., Dept 200N, NYC 10028

"WARI" GAMEBOARDS. Fine tune your thinking as you play. Quality built in solid mahogany and redwood. Ages 8 to adult. You won't be disappointed $30.00. Send check or money order to "Wari", 8206 Flower Avenue, Takoma Park, MD 20912

Miscellaneous

SURVIVE FUTURE times with advanced holistic jungle community. Informative newsletter $1.00. Positive Thinkers, Box 23628NH, Ft. Lauderdale, FL 33307

Music

COURTLY MUSIC for Weddings or Parties. Elegant, Festive, Baroque and Renaissance Music on Recorders. (212) 580-7234

RECORDS-TAPES! Discounts to 73%. All labels; no purchase obligations; newsletter; discount dividend certificates. 100% guarantees. Free details. Discount Music Club, 650 Main Street, P.O. Box 2000, Dept. 25-1282, New Rochelle, NY 10801

Newsletters

NATURE PHOTOGRAPHERS! Stay on top of your markets with The Guilfoyle Report. For information: AG Editions, 142 Bank St., New York City 10014 (212) 929-0959

Optical

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired Large stock. Orders filled postpaid day received. Birding, Box 5N, Amsterdam, NY 12010

Personals

MEET SINGLES Mexico, Orient, Europe, Australia. Free information. Write: International, Box 1716-NH, Chula Vista, CA 92012

Real Estate

FREE! BIG Fall-Holiday Catalogue! Over 5,400 country properties described, pictured! Land, farms, homes, businesses, recreation, retirement values! Selected best of hundreds of offices All Across America! Strout Realty, Inc., Plaza Towers, Dept. 5390, Springfield, MO 65804. Call toll free: 1-800-641-4266; in Missouri call collect (417) 862-4402

FREE CATALOGUE. Describes and pictures farms, ranches, acreages, businesses and town and country homes from coast to coast. United Farm Agency, Inc., 612-U W. 47th St., Kansas City MO 64112. Call Toll-Free: 1-800-821-2599; MO res. call Toll-Free: 1-800-892-5785

GOVERNMENT LANDS . . . FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00. Lands, Box 19107-RM, Washington, DC 20036

RURAL PROPERTY BULLETIN lists hundreds of private rural properties for sale monthly. $12/year, $2/single. Box 2042-NH, Sandpoint, Idaho 83864

Rentals

SKI THE BEST—Breckenridge, Colorado, Downhill & Cross Country. Located on the slopes. Town House—3,000 sq. ft. 2 Decks—Unparalleled View. A Jewel. Condo—Same location also available. 1-800-525-5818

ST. JOHN, VIRGIN ISLANDS apartment for two. Vacation: swimming, snorkeling, exploring National Park. $350 weekly. Barsel, Box 114, St. John, U.S.V.I. 00830

Resorts

CARIBBEAN HIDEAWAY· Very small, very special hotel tucked into a 30 acre plantation on the island of Bequia, St. Vincent Grenadines, W.I. Ten rooms, pool, beautiful beach, snorkeling, hiking, photography, birding, tennis. Write or call: Spring on Bequia, Box 19251, Minneapolis, MN 55419 (612) 823-1202 or your travel agent

JUNGLE VACATION in the Talamanca Rainforest Superb birding, plant and insect hunting. Riding and hiking trails; guides. Weekly rates $225.00 single; $350 double. M.E. Snow, Apartado 73, 7200 Siquirres, Costa Rica

KENYA. Attractive cottage at Lake Naivasha Safaris organized, birders' paradise. $280 per week. Write M. Carnelley, Box 79, Naivasha, Kenya

LITTLE ST. SIMONS ISLAND

One of Georgia's "Golden Isles"

Birding, beachcombing, riding, wildlife photography, fishing or just relaxing on a secluded 12,000 acre island with miles of unspoiled ocean beaches, forests and marshes. Over 200 species of birds. Maximum of 10-15 guests at a time. Excellent food and accommodations. Professional naturalists on the staff. P.O. Box 1078N, St. Simons Island, GA 31522 Phone (912) 638-7472

ST. THOMAS—WATER ISLAND private, secluded, shangrila packages. Studio Apartments, 2-7 day charter yachting, private villa—combinations. Limestone Reef Terraces, RD 4, Princeton, NJ 08540 (201) 329-6309

TOBAGO, PRIVATE BEACH COTTAGES on working cocoa plantation. Swimming, snorkeling, fishing from your front door. Bird watcher's paradise. Brochure. Charles A. Turpin, Charlotteville, Tobago, West Indies

VACATION/RELAXATION—Birdwatcher's delight—Peaceful, secluded nature lover's mountain retreat. Cave Creek Ranch, Portal, Arizona 85632

Tours/Trips

Unusual India & Nepal

Trekking (walking) expeditions to the foot of Mt Everest & Annapurna Wildlife safaris in search of rare Asian birds and mammals. Explorations of remote Bhutan, Sikkim, Ladakh and tropical Sri Lanka. 10 to 35 day programs from $670.00 + airfare. Free Brochures.

Himalayan Travel, Inc.

P.O. Box 481-NH
Greenwich, CT 06830
(203) 622-0055 Toll Free (800) 243-5330

A BEAUTIFUL EXPERIENCE. Learn sailing aboard 50' ketch 'Palisander'. Winter Caribbean, Summer Chesapeake, Spring & Fall Blue Water Cruises. $600/person/week. Cuttyhunk Marine Adventures, c/o Wailes Gray, 77 Tweed Blvd , Nyack, NY 10960

ADIRONDACK WILDERNESS SKI TOURS: Enjoy the exhilaration and beauty of a northern winter in the company of expert instructor/guides. Cross-country ski vacations are five days, limited to 10 guests, geared to all levels of ability. Daily excursions into "forever wild" Forest Preserve. Evenings spent in cozy lodge enjoying hearty meals, good company, and fireside programs featuring Adirondack naturalists, photographers and conservationists. Write: Adirondack Ski Tours, McMaster Rd., Saranac Lake, NY 12983. Call (212) 546-9202

ADVENTURES WITH WILDLIFE—Whale Watch cruises with gray whales, humpbacks and even blue whales. African photo safaris viewing gorillas in Rwanda, wildlife and birds in Kenya, Tanzania, Zambia, Botswana and Madagascar. New brochure with 24 trips. Adventures International, Dept. NC, 4421 Albert, Oakland, CA 94619

AFFORDABLE AFRICA: Own, comfortable, weekly Zebrajet allows fabulous Kenya/Seychelles Adventures. European quality, incredible prices. Example: 17 days $1796, all inclusive (From USA). Wildlife, People, Safari, Indian Ocean. Also: Madagascar ("Living Fossils"), Rwanda (Gorillas), Tanzania, Botswana, Namibia, and More! Forum Travel International, 2437 Durant, Berkeley, California 94704 (415) 843-8294

ALASKAN BIRDS, BEARS, FLOWERS and marine mammals—wildlife photography. Experience remote coastal wilderness, near McNeil River, world's largest concentration of brown bear. Deluxe camp, gourmet meals, guide, floatplane. 6 guests/5 days—$1500.00 each. June-August. Write Chenik Wilderness Camp, Box 956, Homer, AK 99603 (907) 235-8910

ALASKAN WATER ADVENTURES. Kayaking, Rafting, Birding in Prince William Sound and Copper River Basin. College credit available. Open Door. Box 1185N, Cordova, Alaska 99574 (907) 424-7466

ALPS OF SWITZERLAND. "The Hikers Paradise". Moderate optional length Day hiking tours. Two or four weeks. Brochure. Alpine Adventure Trails Tours, 783P Cliffside Drive, Akron, OH 44313

BAHAMAS SAILING ADVENTURE—explore deserted islands, fabulous reefs, on luxurious 40' to 50' sailboats—Reasonable. Captain Lloyd Molby, 128 Golden Gate, #15, Sarasota, FL 33577 1(813) 365-3255

BAJA CALIFORNIA GRAY WHALE EXPEDITIONS on the Qualifier 105 with expert naturalists as leaders. December through March. Elephant seals, sea lions, marine birds, desert island plants, wildflowers and whales for an outstanding natural history experience. Write for free brochure to Nature Expeditions International, Dept. 22NH, 599 College Avenue, Palo Alto, CA 94306

BAJA WHALE-WATCHING. 5 days/4 nights, Scammons Lagoon whale-watching camp, Feb. 14-19, $774. Contact Wilderness: Alaska/Mexico, Dept. NH, 5119½ 27th N.E., Seattle, WA 98105 (206) 522-5315

BEST OF ECUADOR: Most desired Galapagos Cruise, best time of year. February 28-March 13, 1983. 14-day trip includes historic Quito, Otavalo Market, 8 days in Galapagos on M/V Santa Cruz. Our own expert guides emphasize culture, ecology, birds. Pre-trip option: 3 days on floating hotel in Amazonian Ecuador—Unique. Princeton Nature Tours, 282 Western Way, Princeton, NJ 08540 (609) 683-1111

DESERT ECOLOGY SEMINARS: Rafting on the Rio Grande, backpacking in the Big Bend, caravans to Mexico. Chihuahuan Desert Research Institute, Box 1334, Alpine, TX 79830 (915) 837-2475

DISCOVER BAJA! Join experienced naturalists and crew for leisurely ocean-going explorations of the wilderness islands and lagoons of Baja's Pacific coast, the Sea of Cortez, or Mexico's tropical west coast. Enjoy whales, seals, dolphin, birding, fishing, nature study, island hiking, and more! Excellent photo opportunities. Small groups, relaxed pace. Trips 4-10 days year-round for individuals or groups. Color brochure: Pacific Adventures Charter Service, 2445 Morena Blvd., Suite 200H, San Diego, CA 92110 (714) 275-4253

GALAPAGOS HIKING AND SAILING EXPEDITIONS. Small groups-Charters. 8-25 Days. 1983 Departures: April 28, June 25, July 21, July 28, August 22. Options: Ecuador, Peru, Machu Picchu, Diving, World. Inca Floats, Inc., 5982 Balboa Dr., Oakland, CA 94611 (415) 339-9095

GALAPAGOS ISLANDS. Economic tours from $1666 including airfare. 4, 5, 8, & 15 days Galapagos, all meals. Options, mainland Ecuador, Amazon, Cuzco/Machu Picchu. University credit available. Joseph Colley, Last, Inc., 43 Millstone Rd , Randallstown, MD 21133. (301) 922-3116

HIMALAYA
TREKKING AND WILDERNESS EXPEDITIONS
Physical and cultural quests for the spirited adventurer in remote China, Nepal, Ladakh, New Zealand, Japan and more. For a beautiful TRAVEL PORTFOLIO detailing more than 20 unique trips around the world send $2 to 1802-N Cedar St., Berkeley, CA 94703. (415) 540-8031.

JOURNEY WITH WHALES along Baja California aboard the 'Pacific Queen'. Gray whales, elephant seals, dolphins; island, lagoon exploration; superb bird photography. 8/9 day expeditions December-April. 'Pacific Queen'/Fisherman's Landing, 2838 Garrison Street, San Diego, CA 92106 (714) 726-2228; (714) 224-4965

NATURE & CULTURE Tours: Latin America (Peru, Ecuador, Galapagos, Unknown Bolivia, Mayaland). Africa. China. Egypt/Israel (Hiking, Archaeology). Europe. Western USA/Canada. Australia, Etc! Groups/Individuals, Reasonable Priced. Also: Safaris, Hiking, Special Interests. Forum Travel, 2437 Durant, Berkeley, California 94704 (415) 843-8294

NEW ZEALAND WALKABOUT: Escorted nature and hiking tours featuring New Zealand's scenic National Parks, plus the Milford Track. Pacific Exploration Co., Box 3042-N, Santa Barbara, California 93105 (805) 687-7282

OCEANOGRAPHIC EXPEDITION: Divers, naturalists needed for reef research project. Vanuatu, Solomons, Papua-New Guinea. Share expenses, chores, sailing. Three 1983 segments begin: June, August, October. Box 1644, Brisbane 4001, Australia

PEACEFUL COSTARICA, "Natural History Showcase": 8 & 15 day tours. 848 bird species, 3000 orchids. Seek Resplendent Quetzals, Tropical Mammals. Enjoy, wander, perhaps raft. Forum Travel, 2437 Durant, Berkeley, California 94704 (415) 843-8294

PERRY MASON SAFARIS. 25 YEARS EXPERIENCE. Kenya. Personalized safaris. Contact Box 1643, Darien, CT 06820 (203) 838-3075

READY TO TRAVEL? Plan ahead with finest maps! $1.00 catalogue. Eagle Eye, Box 751-N12, Paonia, CO 81428

TRAVEL FORGOTTEN MEXICO: Oaxaca, Tehuantepec, Chiapas. Finest native art. Easter celebrations. Group size: 12. Expert leadership. Write: Gordon Frost, Box 471-NH, Newhall, CA 91321

UNIQUE TRAVEL BOOKS! Exploration, nature/wildlife, maps, languages. Free catalogue! Wayfarer Books, Box 1121-NL, Davenport, Iowa 52805

RATES AND STYLE INFORMATION

$2.00 per word, 16 word ($32) minimum. *Display classified* is $200 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY to: The Market, NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024. Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—1st of the month, two months prior to cover date (the January issue closes Nov. 1). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

Celestial Events

by Thomas D. Nicholson

All Month We are hard pressed to find an impressive "Christmas Star" this year. The best we can suggest for an "exceptional event" is the total lunar eclipse of Christmas week. But don't overlook the winter sky itself. In the west, the early evening still features the three bright stars of the Summer Triangle: Altair, Deneb, and Vega. Deneb stands highest of the three, with the Northern Cross upright and easy to see beneath it, and the Milky Way slashing past it. The east, of course, contains the brightest stars of the year—those of Orion, Canis Major, Canis Minor, Gemini, Taurus, and Auriga ranged along a great "belt" from south to north.

The planets are not at their best this month but they give promise of better things to come. Late in December, you should find Venus low in the sunset twilight, setting early but bright enough to pick out easily, with Mercury a bit higher to its left and setting later. From here on, Venus becomes slowly but increasingly prominent as an evening star this winter and spring. Mars, on the other hand, much higher in the southwest after dark than Venus, is on its way out of the evening sky.

Saturn is now much easier to find in the morning, rising in the east in Virgo to Spica's left well before dawn. Jupiter is also a morning star but doesn't rise early enough to be seen until late December, when it shows up low in the east, below Saturn, at dawn. Both Saturn and Jupiter will become more and more evident among the stars in the months ahead.

If you watch the lunar eclipse, you will

Total Lunar Eclipse
December 30, 1982

Event	Eastern Standard Time	Central Standard Time	Mountain Standard Time	Pacific Standard Time
Moon enters umbra Eclipse begins as earth's shadow appears on left (east) edge of moon.	4:50 A.M.	3:50 A.M.	2:50 A.M.	1:50 A.M.
Total eclipse begins Moon is fully immersed in earth's shadow.	5:58 A.M.	4:58 A.M.	3:58 A.M.	2:58 A.M.
Middle of eclipse Moon is darkest and deepest in shadow.	6:29 A.M.	5:29 A.M.	4:29 A.M.	3:29 A.M.
Total eclipse ends Sunlight appears at left (east) edge of moon as it leaves earth's shadow.	6:59 A.M.	5:59 A.M.	4:59 A.M.	3:59 A.M.
Moon leaves umbra Eclipse ends as earth's shadow disappears from right (west) edge of moon.	8:07 A.M.	7:07 A.M.	6:07 A.M.	5:07 A.M.

Konrad Lorenz
The Year of the Greylag Goose

Year of the Greylag Goose (Konrad Lorenz)/150 full color phototgraphs/$20.00 (members' price **$13.00**). Lorenz' famous tribute to this lovely bird. "In every sense, this is a beautiful book" *—Publisher's Weekly.*

GALAPAGOS
Islands Lost in Time

Galapagos: Islands Lost in Time/300 full color photos/$30.00 (members' price **$27.00**). "Beautiful and sensitive photographs"—Stephen Jay Gould, *New York Review of Books.*

DAVID ATTENBOROUGH
Life on Earth

Life On Earth (David Attenborough)/118 full color photos/$22.50 (members' price **$19.00**). "A fascinating introduction to natural history"*—New York Times.*

TO THE ENDS OF THE EARTH

To the Ends of the Earth: Four Expeditions to the Arctic, the Congo, the Gobi, and Siberia/$27.50 (members' price **$23.00**). "A wonderfully evocative book"*—Audubon Magazine.*

MAN AS ART
NEW GUINEA

Man as Art/63 full color plates, 31 duotones/$45.00 (members' price **$40.00**). "We have never received a more beautiful book"*—Primitive Art Newsletter.* "Haunting...spectacular"*—Smithsonian.*

SPIRALS FROM THE SEA

Spirals from the Sea: An Anthropological Look at Shells/More than 60 full color photos/$35.00 (members' price **$29.00**). Based on the Museum's celebrated Hall of Mollusks and Mankind

The Life of the Harp Seal/70 full color photos/$25.00 (members' price **$15.00**). In vivid color photographs, the author chronicles the life of the harp seal from the Gulf of St. Lawrence to the Arctic Sea.

Dinosaurs, Mammoths, and Cavemen

Dinosaurs, Mammoths, & Cavemen: The Art of Charles R. Knight/Over 100 full color plates/$24.95 (members' price **$22.00**). Knight gave us our vision of what prehistoric life looked like. "None has excelled him"—Edwin H. Colbert

SPECIAL BENEFIT FOR MUSEUM MEMBERS

Eight magnificent natural history books selected expressly for Members of the American Museum of Natural History. Available to Members at large discounts up to 40% off the publisher's price. For your holiday gift-giving convenience, a blank gift card and envelope will accompany every order.

Members' Book Program BMB
American Museum of Natural History
Central Park West at 79th Street
New York, NY 10024.

I would like to order the following books:

Title	Quant.	Price

U.P.S. Delivery, add $2.50 for first book plus $1.00 for each add'l book. FREE DELIVERY with order of 5 or more books. ______

Total enclosed: ______

Name: ______

Address: ______
(Note: U.P.S. will not deliver to P.O. boxes)

City: ______ State: ______ Zip: ______

Please charge my credit card account (circle one)
MASTERCARD VISA

Acct. #: ______ Exp. date: ______
(All numbers, please)

Signature: ______

Please make checks payable to: American Museum of Natural History

To obtain these special discounts in the Museum Shop, please present this coupon with your membership card. Special discounts apply in lieu of regular members' discounts.

Special Holiday Offer!

CASHMERE MUFFLER
—$39.95
(while our supply lasts)

The choice Mongolian cashmere in this elegant muffler is incomparably soft, smooth, and supple. Wear it, and enjoy both matchless warmth and a striking look of luxury. 52" long by 12" wide, finished with the traditional Scottish scarf fringe.

Available in 5 tasteful shades: heather beige (oatmeal), gray, burgundy, navy, and off-white. Special pre-season price is just $39.95, plus $3.00 for insured shipping and handling. (For deliveries in N.Y., add sales tax.) Satisfaction guaranteed, or return within 30 days for refund of full purchase price.

AN IDEAL GIFT! Include name and address of each recipient, and we'll ship gifts individually, with a card in your name.

SAVE MORE! On 2 or more mufflers sent to same address, pay only a single shipping charge of $3.00. (Corporate quantity discounts available.)

For same-day shipment, call 800-221-2433 *toll-free*, to order by VISA, MasterCard, or American Express. In N.Y., call 212-889-0033.

Or mail check with your order to:
SAMUEL LEHRER & CO., INC., Dept.NH-2,
419 Park Avenue South, New York, N.Y. 10016.

- MEXICO
- PERU
- and other global destinations

wandering wings

Nature and Birding Tours
Trekking, Sport Fishing, Study and General Tours

uniclam travel inc.
250 West 54th Street, N.Y.C. 10019
(212) 664-7611 • (800) 223-0991

Wildlife Tours

Wildlife safaris Tanzania, Kenya, Botswana

Gorilla viewing Rwanda

Andes, Amazon and Galapagos islands

many other trips

Travel with the experts

Adventures International
4421-N Albert St., Oakland, CA
(415) 531-6564

see that the part of the moon within the earth's shadow does not look completely dark. It is illuminated by sunlight bent around the earth (refraction) and into the shadow by the earth's atmosphere. This usually gives the moon's surface a dull, coppery-red appearance, which varies in brightness and color within different parts of the earth's shadow and from eclipse to eclipse.

December 1: The moon was full on November 30 and tonight's gibbous moon is in Taurus, rising soon after sundown, moving between El Nath (above) and Zeta Tauri (to the right), the stars that mark the "horns" of the Bull.

December 2: Perigee moon (nearest the earth) occurs this morning, and will "stretch out" the higher spring tides that followed the full moon. Expect continuing higher tides tonight and tomorrow.

December 3: The waning gibbous moon rises several hours after sunset, in line with and below the "twin" stars, Pollux and Castor, in Gemini.

December 5–6: Shortly after moonrise (about 10:00 P.M.), look for Regulus, the bright star of Leo, below and to the moon's left. The moon moves east (left) toward Regulus during the night as both drift westward across the sky, passing Regulus on the morning of the 6th.

December 7: Last-quarter moon, rising about midnight near the autumnal equinox, where the sun is located when fall begins each September. The bright star above the moon is Denebola, at the "tail" of Leo, the Lion.

December 8: The earliest sunset of the year occurs today.

December 10: The waning crescent moon rises before dawn near Spica (the bright star of Virgo) and Saturn.

December 12: The waning crescent moon may still be visible in the east just before and during morning twilight. Look early and you may also see two second-magnitude stars nearby, Zubenelgenubi to the moon's right and Zubeneschamali above it. These are the two brightest stars of the constellation Libra.

December 13: Jupiter and the moon are in conjunction, but they rise in the morning twilight too late to be seen.

December 14: The Geminid meteor shower, second only to the Perseid shower of August in reliability and production, is at maximum. You may see up to fifty meteors per hour in the small hours of the 14th.

December 15: New moon is near the winter solstice in Sagittarius.

December 17: The apogee moon (farthest from the earth) may be visible as a

LUNATION
. . . the period required for one complete cycle of the moon's phases. Now you can illustrate this fascinating progression with the acclaimed

LUNAR PHASE POSTER

This 40 x 93 cm color chart shows the correct phase of the moon for every day of the year. Created by an astronomer with you in mind—don't be without one.

Rolled in a tube. Order LPP83. $6.00 ppd.

VISA CELESTIAL PRODUCTS Inc. MC
10 W. WASHINGTON ST.
MIDDLEBURG, VA 22117
703-687-6881

In 1974 we originated our epoch-making ***Galapagos Islands Thrift Cruises,*** *which for several years enabled many hundreds of budget-minded travelers who were interested in ecology, wildlife and photography to see these unique islands without luxurious trimmings but under expert guidance.*

Since last year, we offer a budget program including some of the highlights which make a visit to this remarkable archipelago such a renowned tourist attraction. We explore five of the islands in order to view sea lions, iguanas and a large variety of birds, such as the famous Darwin's finches, boobies, frigates and gulls.

Galapagos Islands Thrift Program™

MARCH 31 TO APRIL 10, 1983
JUNE 30 TO JULY 10, 1983
AUGUST 11 TO 21, 1983
DECEMBER 31, 1983 TO JANUARY 8, 1984

Our program includes easy hikes on Santa Cruz to see tortoises roaming free and to the top of the dormant volcano at Sullivan Bay, and ample opportunities for swimming and snorkeling. It is ideal for young people and families with children and has been planned during periods of school and college vacations.

We do not claim that these programs are as comprehensive as our superb and unrivalled **Discover Galapegos** yacht cruises in January, May and August, 1983; but our meticulously supervised arrangements do provide you with a fascinating introduction to these wonderful islands—and at a third of the cost.

Each program is accompanied by one of our expert leaders and a naturalist guide who give informative talks and lead us in the field.

Before the week at the islands, we spend two days at the best hotel in Quito, Ecuador's lovely capital in the Andes.

Please send for the detailed brochure of these programs — we also specialize in expeditions to Greenland, Mount Kilimanjaro, the Himalayas and the Andes; wildlife safaris to see polar bears in northern Canada and to Scotland, Borneo and Rajasthan, and archeological tours to Peru and Egypt.

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

TRINIDAD RAIN FOREST

The **ASA WRIGHT NATURE CENTRE** offers the most convenient introduction to this rich tropical world of nature. Located on the northern mountain range, the Nature Centre provides a comfortable and attractive retreat.

- Rustic plantation setting
- Guides available
- Field trips
- Excellent photographic opportunities
- Five summer seminars

Write or call: **WONDER BIRD TOURS**, Dept. A10, 500 Fifth Avenue, New York, N.Y. 10036. Phone: 212/840-5961.

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: BOOKS-ON-FILE

Box 195 Dept. 72
UNION CITY, NEW JERSEY 07087

MATH WITHOUT TEARS

Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written. ***Learn math in the comfort of your own home at minimum cost.***

Order Now $11.95 plus $1.25 hdlg.
EMERSON BOOKS, INC.
Dept. 710-G, Verplanck, NY 10596
10 Day Money Back Guarantee

We repeat the enormously popular and unusually interesting outdoors programs to the Andes and the Himalayas where our small groups are expertly led by capable mountaineers:

Inca Trek in Peru

JULY 17 TO AUGUST 1, 1983
AUGUST 7 TO 22, 1983

These expeditions provide the stirring experience of walking along the ancient Inca trail from Cuzco high above the lovely Urubamba Valley, at a leisurely pace over three passes and through fabulous Andean scenery to Machu Picchu, the most dramatically spectacular archaeological site in the world. Before and after the trek, first class hotel accommodations are provided in Lima and Cuzco.

Himalayan Trek in Nepal

NOVEMBER 20 TO DECEMBER 15, 1982
FEBRUARY 5 TO MARCH 2, 1983

These expeditions are unique not only due to the expert leadership but because they combine a trek on foot in the Annapurna region with a trek on elephant back through the Terai jungle, and a canoe trip on the Rapti River. Between the treks, first class hotel accommodations are provided; and the expedition ends with five days in Northern India, visiting Delhi, Agra and Jaipur.

Detailed brochures are available from:

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

slim crescent in evening twilight, at the western edge of Capricornus.

December 18: Look for the crescent moon in the southwest at dusk. You should see it pass from right to left below Mars, closest to the planet at about 8:00 P.M., EST.

December 21: At 11:39 P.M., EST, the sun is 90 degrees (6 hours) west of the vernal equinox and 23½ degrees south of the equatorial plane at a point in the constellation Sagittarius called the winter solstice. This marks the beginning of winter in the Northern Hemisphere. Note that it is not the date of the earliest sunset or of the latest sunrise (January 6), although it is the "shortest" day of the year as measured by the total interval during which the sun is above the horizon.

December 22: Maximum of the Ursid (from Ursa Major, the Great Bear) meteor shower is at 2:00 P.M., EST. You may see up to fifteen shower meteors per hour during the dark, moonless morning hours today and tomorrow.

December 23: The moon is at first-quarter, setting at midnight in the constellation Pisces.

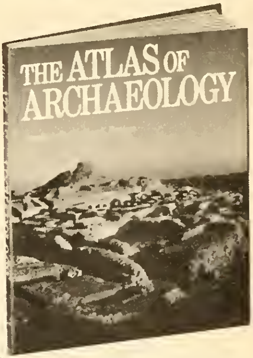
December 27: The fuzzy-looking group of dim stars to the right and above the moon is the Pleiades (Seven Sisters) in Taurus. The moon moves left away from them and closer to Taurus's brightest star, Aldebaran, during the night, passing above Aldebaran during the day on the 28th.

December 30: Full moon occurs at about 6:33 A.M., EST, in Gemini, and a total lunar eclipse is visible throughout North America (see box). Two bright stars to the east and above the moon are Pollux (the brighter) and Castor, the "twin" stars. Perigee moon (nearest the earth) also occurs today. Mercury is at maximum distance to the sun's left (greatest easterly elongation), best located for viewing as an evening star. It is low in the west-southwest at twilight. Venus is also there, much easier to see because of its brightness. With Venus in view, look for Mercury to the left. Their positions relative to each other and to the setting sun are about the same for several nights before and after the 30th.

December 30–31: With perigee occurring only 10½ hours after full moon on the 30th, watch for exceptionally strong tides late that night and during the day on the 31st, as the perigee effect adds to the full moon spring tide.

Editor's Note: The Sky Map in the October issue shows the evening constellations and stars for this month and gives the times for use.

THE ATLAS OF ARCHAEOLOGY



Sweeping from classical Europe to the Indus Valley to pre-Columbian America, *The Atlas of Archaeology* offers a tour both of the ancient world and of modern science.

Written by a team of international experts, this far-ranging survey traces the history of archaeology itself—while bringing to life the legendary civilizations that built Persepolis, the Ming Tombs, and other monuments.

Scores of photos, maps, diagrams, and artists' reconstructions—many in full color—clarify and enliven the text of a lavish, oversize volume that is not only authoritative but utterly fascinating as well. Selected by the Book-of-the-Month Club and the History Book Club. 240 pages; 120 photos, illustrations and diagrams.

The Atlas of Archaeology
Edited by Keith Branigan
At bookstores, or shop at home by ordering direct from the publisher:

NH-1282

Please return this coupon to:
St. Martin's Press
175 Fifth Avenue, New York, N.Y. 10010 Attn: JW
Please send me ______copy(ies) of *The Atlas of Archaeology* @ $25.00 each. Please add $1.50 per book for postage and handling. My check or money order is enclosed in the amount of $______. I may examine the book for thirty days and, if not 100% satisfied, I can return it for a complete refund.

Name______
Address______
City______
State______Zip______

NORTH POLE
VISIT THE TOP OF THE WORLD

The ultimate travel experience—standing on top of the world! Our small groups visit with frontier Eskimos, fish through Lake Hazen's ice for arctic char, and may sleep in an igloo. Experienced bush pilots and our special hydraulic-ski equipped aircraft make the expedition possible. We fly the last 500 miles to 90°N, where few adventurers have ever been, and marvel at the dramatic beauty of the frozen far north. Experience all but the Polar attempt on PROJECT HIGH ARCTIC AND NORTHWEST PASSAGE. Departures in April and May 1983.

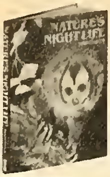
PROJECT NORTH POLE Limited to 12; 11 days. $7450.
PROJECT HIGH ARCTIC Limited to 14; 11 days. $4950.

Society Expeditions
Dept NH 723 Broadway East, Seattle, WA 98102

I would like to know more about your High Arctic programs. Please forward your complete itinerary

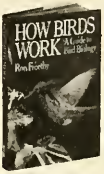
Name
Street
City/State/Zip 8212N

HAVE YOU THOUGHT ABOUT TAKING AN ENLIGHTENING TRIP INTO THE WORLD OF DARKNESS?



NATURE'S NIGHT LIFE, Robert Burton, transports you into a world of mystery, wonder and dazzling beauty. You'll discover:
★ Rare photos—63 in spectacular full color!
★ Animals rarely seen in daylight—or at all!
★ Scorpions, nightingales, bats, and dozens more.
★ An entrancing, infectious narrative!
★ And much, much more!

You'll learn why their special senses enable them to be more successful at night—and why their biological clocks differ from most. Order your copy today. 160pp. 7⅞ x 9¾ Hardcover $17.95



HOW BIRDS WORK, Ron Freethy, takes you on a fascinating flight into the history, habitats and lives of birds. A highly readable style, plus photos and drawings throughout will amaze birdwatchers, birdlovers, and naturalists alike. And all of you who remain curious and spellbound by the magic of flying itself. 182pp. 6¼ x 9¼ Hardcover $15.95

STERLING PUBLISHING CO., INC., Dept. NH-1
Two Park Avenue, New York, N.Y. 10016
Yes! Please send me the book(s) checked. My check or money order enclosed for $____ (Include $1.50 for postage & handling—order both and Sterling will pay postage).
____ Nature's Night Life $17.95
____ How Birds Work $15.95
Name
Address
City, State, Zip

Now—The Fitness Master XC-1 Opens the Way to Aerobic Fitness

By simulating cross country skiing, the Fitness Master XC-1 offers you a total system for cardiovascular fitness and body tone. Firms your entire body: arms and upper torso, legs, and buttocks. Excellent for weight control.
- Easy to attain target heart rates since more muscles used means less effort per muscle.
- Fluid motions—no jarring impact on bones and joints. Avoids running related injuries.
- Leg and arm motions are independent, with totally adjustable resistance. Can be used by men or women, regardless of size or weight. Height adjustable.
- Stable—rests flat on the floor and has side rails for extra security.
- Elegant design—sleek, durable, chrome plated steel. Fine workmanship.
- Easily disassembles to 5" height—slips under your bed!
- The best that money can buy. Convenient for home or office.
- 15 day home trial. 2 Year Warranty.

For more information and a free brochure call
TOLL FREE: 1-800-328-8995; in Minnesota: 1-612-448-7876
8-5 Mon.-Fri.—FITNESS MASTER, INCORPORATED,
12 Haverhill, Jonathan, Minnesota 55318.

Star Gods of the Ancient Americas

According to a belief of the Northwest Coast Indians, Raven created the world from darkness. But to illuminate his creation, he had to steal, through trickery, the sun, moon, and stars from the chief of heaven, who kept them hidden away in boxes.

Recently the Museum of the American Indian brought out from its exhibits and storage rooms more than one hundred Indian artifacts depicting the sun, moons, and stars. These pieces, many of which have not been exhibited, include carvings, chased goldwork, pottery and sculpture, mosaics, and decorated textiles and leather. These objects will be featured in a major exhibition at the American Museum of Natural History entitled *Star Gods of the Ancient Americas.* Opening December 3 in Gallery 3, the exhibition is the first comprehensive one devoted to the astronomy of the New World. It will focus on the roles of astronomy, astrology, and cosmology in the lives of Indians of the Americas during the past 3,000 years.

The exhibition points out just how important the motions of the heavenly bodies were to these ancient cultures. The sun, moon, stars, and planets were intimately connected with almost every aspect of life: observations of the sky dictated planting, harvesting, and hunting; guided predictions of seasonal rains and floods; and often affected the important decisions made by rulers. Elaborate and sophisticated observatories, especially in Mesoamerica, were built for watching the movements of the heavens. The Maya, for example, were such accurate astronomers that their calendar was the most precise in the New World; furthermore, their observations were recorded over long periods, allowing rulers and priests to predict such phenomena as eclipses of the sun and moon. Many of their written texts remain undeciphered, but some clearly show symbols of astronomical phenomena, indicating that a wealth of information has yet to be revealed.

Most cultures of the Americas deified

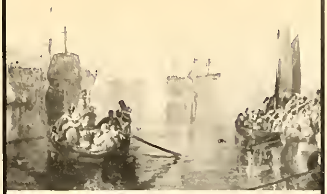
the heavenly bodies, especially the sun and moon. For example, among the artifacts featured in the exhibit is a nine-inch, solid gold sun mask depicting the golden-rayed face, surrounded by serpent and hawk, of the Inca sun god. Still another interpretation of the sun can be seen in a large, carved mask of the people of British Columbia. Traditionally the mask was opened and shut by a dancer to reveal the dual aspects of the sun, perhaps day and night or summer and winter. The dancer circled the fire, enacting the movements of the sun god in his walk across the sky.

A gold calendar disk of the Huari-Tiahuanaco culture of Peru may also portray the sun, and numerous symbols and glyphs around the perimeter (which have yet to be translated) seem to represent

Ownership Statement

Statement of ownership, management, and circulation (required by 39 U.S.C. 3685) of *Natural History*, published twelve times a year at the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024, for October 1, 1982. General business offices of the publisher are located at Central Park West at 79th Street, New York, N.Y. 10024. Publisher, L. Thomas Kelly; editor, Alan P. Ternes, Central Park West at 79th Street, New York, N.Y. 10024. Owner is the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Known bondholders, mortgagees, and other security holders owning or holding one percent or more of total amount of bonds, mortgages, or other securities: None. The purpose, function, and nonprofit status of this organization and the exempt status for federal income tax purposes have not changed during preceding 12 months (Section 132.122, Postal Service Manual). The average number of copies of each issue during the preceding 12 months are: A. Total number of copies printed: 514,229; B. Paid circulation: 1. Sales through dealers and carriers, street vendors, and counter sales: 18,606; 2. Mail subscriptions: 447,020; C. Total paid circulation: 465,626. D. Free distribution by mail, carrier, or other means: 15,284. E. Total distribution: 480,910. F. Copies not distributed: 1. Office use, leftover, unaccounted, spoiled after printing: 12,936. 2. Returns from news agents: 20,383. G. Total: 514,229. The actual number of copies of single issue published nearest to filing date are: A. Total number of copies printed: 515,500. B. Paid circulation: 1. Sales through dealers and carriers, street vendors, and counter sales: 18,892. 2. Mail subscriptions: 454,696. C. Total paid circulation: 473,588. D. Free distribution by mail, carrier, or other means: 16,131. E. Total distribution: 489,719. F. Copies not distributed: 1. Office use, leftover, unaccounted, spoiled after printing: 6,256. 2. Returns from news agents: 19,525. G. Total: 515,500. I certify that the statements made by me above are correct and complete.

L. T. Kelly, Publisher



UNIQUE TURNER OFFER

Saltash, Cornwall: (21 × 17 in.)
(Signed J.M W. Turner 1825)

Superb quality colour print of one of the most beautiful of all Turner's watercolours. An essay in blues and golds with splashes of red. Art critic John Ruskin wrote in 1835 "The play of light on the sea surface . . . infinite purity of colour . . . quite incomparable."

Just one thousand copies of this painting were printed in England to commemorate Britain's Maritime History Year. We have every one of them. There will be no more available once these few are gone.

Print $16 (Framed $59.90)
Calif. residents add 6½% tax. Tel. (213) 452-2443

OXFORD GALLERIES
2210 Wilshire Blvd., Suite 627
Santa Monica, CA 90403

Name__________
Address__________
City__________ State_____ Zip_____
☐ VISA ☐ M.C. #__________ Exp._____

CEDAR SHOE TREES

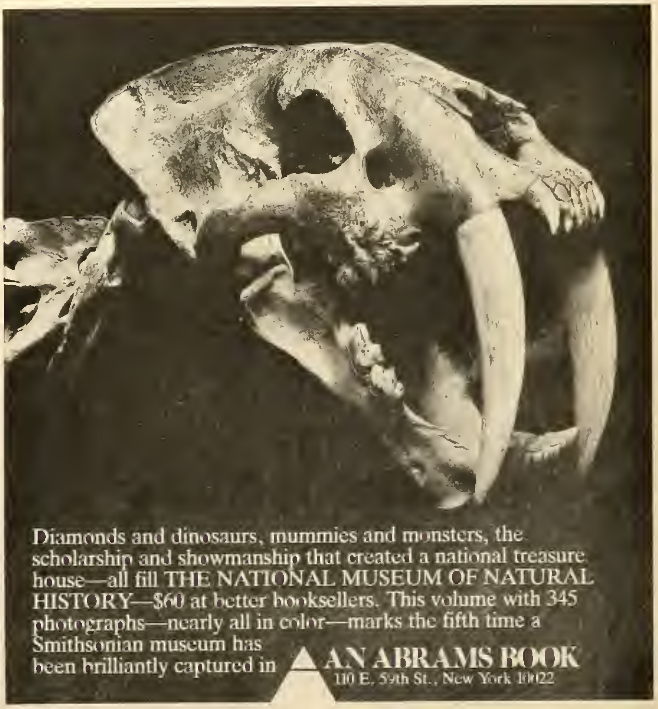
Use in all your fine footwear to absorb harmful moisture, maintain proper shape and impart a fresh, clean scent. **Sizes:** Men's S(6W-8N), M(8W-10N), L(10W-12N), XL(12W-14N). Women's S(4W-6N), M(6W-8N), L(8W-10N). Pair **$12.95** ppd.

Order Today! Money Back Guarantee!

Here is my check or money order for $________
(Add sales tax for shipment into CA, CO, D.C., IL, MI, PA, WA).
☐ **#3305 Men's Cedar Shoe Trees** Size______
☐ **#3308 Women's Cedar Shoe Trees** Size______
Name__________
Address__________
City__________
State______ Zip______
☐ **Send me your FREE color catalog of quality outdoor apparel and equipment.**

Eddie Bauer®

Dept. GNH, Fifth & Union, Seattle, WA 98124



Diamonds and dinosaurs, mummies and monsters, the scholarship and showmanship that created a national treasure house—all fill THE NATIONAL MUSEUM OF NATURAL HISTORY—$60 at better booksellers. This volume with 345 photographs—nearly all in color—marks the fifth time a Smithsonian museum has been brilliantly captured in AN ABRAMS BOOK
110 E. 59th St., New York 10022

Authentic Old
45" Tall
Solid Copper
FIRE
EXTINGUISHER
LAMP

Remember how reassuring it used to be to see one of these gleaming beauties—a solid copper 2½ gallon hand fire extinguisher—standing proudly in a schoolroom, municipal office, theater, and other public places . . . all charged up and ready to go!

Now, we've brought back this authentic piece of the past, complete right down to the engraved instructions, rubber hose, and high-pressure nozzle . . . as part of a striking lamp, for you to enjoy as a dramatic decorative accent in your office or home. Beautifully refinished and lacquered for easy care and extra eye-appeal. Complete with a handsome 17" burlap drum shade. Our supply is limited. When they're gone, they're gone forever! $250.00. 2 or more—$225.00 each. Satisfaction guaranteed. Specify black or natural shade. Add $7.50 each shipping & handling ($10 ea. West of Mississippi River). N.Y. state residents add sales tax. Send check or money order or charge to your MasterCard, VISA, or American Express card.
(Call 315-655-3433), CAZENOVIA ABROAD LTD., 67 Albany St., Dept. NH-1, Cazenovia, N.Y. 13035.

Knit In
New England
Jackie Cooper's
FOLK ART
SWEATERS
featuring your
favorite farm
animals.

Shown: Horses
on Snow $72.

Send $1 for a catalogue of our
Folk Art Sweaters, Suedes and Lace.
Star Route Co., Box 188 J Ashfield, MA 01330

Omaha Steaks International
Happy Holidays!

Let your *last-minute* gift recipients know they come first.

Send magnificent, aged Omaha Steaks to everyone on your last-minute gift list. Tender, juicy, corn-fed beef — the perfect gift for family, friends and business associates.

Call right away, and we'll deliver your order of insta-frozen steaks in a sturdy, reusable cooler.

And just in time for the holidays. Complete satisfaction guaranteed. **Order by December 10th to assure delivery in time for the Yuletide Season!**

Holiday Special —*Limited offer*

Six 6 oz. Filet Mignons, 1¼" thick
Save $18.00 (reg. $47.50) .... **NOW $29.50**
(plus $3.00 shipping)

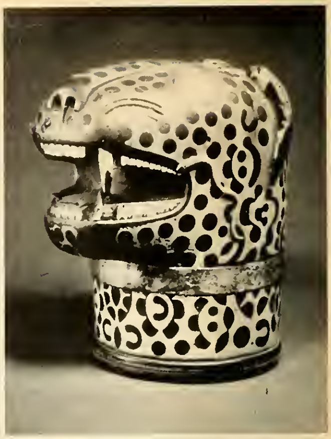
SAVE EVEN MORE!

Twelve 6 oz. Filet Mignons,
1¼" thick. .... **ORDER NOW $56.50**
(plus $3.00 shipping)

Valid in 48 states until December 10, 1982.
Use major credit cards and... Call FREE 1-800-228-9055
In Nebraska, call COLLECT 0-402-391-3660
Operators are standing by to take your order. Ask about other exciting last minute gift specials!

Omaha Steaks International®
Dept. 1790, P.O. Box 3300, Omaha, Nebraska 68103

Museum of the American Indian



Inca jaguar-head drinking cup

points of the solar year such as solstices, equinoxes, and zeniths. A far different calendar is the remarkable document of the Sioux Indians known as Long Soldier's Winter Count. This painted roll of muslin with a spiral of symbols is a historical record of the Sioux between 1798 and 1902; to help the tribe's historian recall the year, each symbol depicts the year's most significant event. Some of the events were astronomical. A star in one corner represents the spectacular meteor shower of 1833 (which was pictured on many other

Dinizulu

Dinizulu and His African Dancers, Drummers, and Singers will appear at the Museum on December 12 for two free performances at 1:00 and 3:00 P.M. in the Kaufmann Theater. A professional company since the late 1940s, the Dinizulu troupe has performed all over the United States and in West Africa. Tickets will be distributed on a first-come, first-serve basis starting at 11:30 A.M. near the first-floor Information Desk; because seating is limited, no more than two tickets will be given to any one person in line.

Stravinsky for Kids

The Bloomingdale Chamber Orchestra will present a children's concert in the Kaufmann Theater on Sunday, December 19, at 3:00 P.M. The free concert will include Stravinsky's *Soldier's Tale* (with a narrator and mime) and a mini-carnival with music of Trinidad by the composer Barrajanos.

Lecture Series

In conjunction with the opening of *Star Gods of the Ancient Americas*, the Education Department will present a series of three lectures on *Archeoastronomy of the*

Sioux Indian winter counts); an even more interesting symbol is a star with a tail—a meteorite fall in 1821 or 1822—described by the tribe historian as the "time comet fell on the ground with a loud noise."

Other astronomical objects on exhibit include a group of seven-foot-high Tlingit house posts carved with the phases of the moon; a jaguar-head cup made of gold and painted wood, with which the Incas may have offered beer to the sun god on the winter solstice; a rare gourd rattle of the Pawnee Indians that shows the four cosmic pillars of the universe; and a superb turquoise mosaic shield of the Mixtec Indians of Mexico illustrating the birth of the sun god in the underworld.

The exhibit begins with sections devoted to the sun, moon, stars, and planets, and objects are displayed cross-culturally. It also provides a comprehensive look at the astronomy of five cultural groups: the Plains Indians; the Pueblo Indians; the Maya empire; other Central American cultures; and the Andean cultures of Peru and Bolivia. The final part of the exhibition is a short film, *Star Lore*, an animation of five Native American myths.

Star Gods of the Ancient Americas will be on exhibition until March 27, 1983. It was organized by the Museum of the American Indian and is supported by a grant from the National Endowment for the Humanities.

Douglas J. Preston

Americas. On December 1, Anthony Aveni will give a slide-illustrated lecture on *South American Archeoastronomy: Inca Astronomy and Nazca Ground Drawings*, in which he will present some new and interesting theories about the purpose of the Nazca drawings. On December 8, Susan Milbrath will lecture on *Astrology and Destiny among the Aztec and Maya*. She will discuss the ways that Aztec and Maya cosmology, astronomy, and fatalistic world views found expression in myth, art, and religion. And on December 15, Von Del Chamberlain will discuss North American Indian winter counts records and beliefs about the sky in *Native American Portraits of the Sky*. Cost of the three-lecture series, which will take place from 7:00 to 8:30 P.M. in the Auditorium, is $18. Tickets to individual lectures, if available, may be purchased at the door for $7.50 each.

For more information call the appropriate department: Education Department (212) 873-1300; Membership Office (212) 873-1327; Planetarium (212) 873-1300; or write to the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024.

¡Speak Spanish like a diplomat!

What sort of people need to learn a foreign language as quickly and effectively as possible? *Foreign service personnel,* that's who. Members of America's diplomatic corps are assigned to U.S. embassies abroad, where they must be able to converse fluently in every situation.

Now you can learn to speak Spanish just as these diplomatic personnel do—with the Foreign Service Institute's Programmatic Spanish Course. You'll learn Latin American Spanish recorded by native speakers.

The U.S. Department of State has spent thousands of dollars developing this course. It's by far the most effective way to learn Spanish at your own convenience and at your own pace.

The course consists of a series of cassettes and accompanying textbook. Simply follow the spoken and written instructions, listening and repeating. By the end of the course, you'll be learning and speaking entirely in Spanish!

This course turns your cassette player into a "teaching machine." With its unique "programmatic" learning method, you set your own pace — testing yourself, correcting errors, reinforcing accurate responses.

The FSI's Programmatic Spanish Course comes in two volumes, each shipped in a handsome library binder. You may order one or both:

☐ **Volume I: Basic.** 12 cassettes (17 hr.), manual, and 464-p. text, $115.
☐ **Volume II: Intermediate.** 8 cassettes (11½ hr.), manual, and 614-p. text, $98.
(Conn. and N.Y. residents add sales tax)

TO ORDER BY PHONE, PLEASE CALL TOLL-FREE NUMBER: **1-800-243-1234.**

To order by mail, clip this ad and send with your name and address, and a check or money order — or charge to your credit card (AmEx, VISA, MasterCard, Diners) by enclosing card number, expiration date, and your signature.

The Foreign Service Institute's Spanish course is unconditionally guaranteed. Try it for three weeks. If you're not convinced it's the fastest, easiest, most painless way to learn Spanish, return it and we'll refund every penny you paid!

81 courses in 26 other languages also available. Write us for free catalog. Our 10th year.

AUDIO-FORUM®

Audio-Forum
Suite 20-B
On-the-Green,
Guilford, CT 06437
(203) 453-9794

All orders received by Dec. 13 will be delivered before the holidays!
Or visit our New York sales office: 145 E. 49th St New York, N Y 10017 (212)753-1783

COLOR PHOTOGRAPHIC PRINTING

▼
CIBACHROME COLOR PRINTS OFFER PERMANENCE, BRILLIANCE AND FIDELITY TO YOUR ORIGINAL TRANSPARENCIES

▼
At AZO LABS, we work closely with artists, museum directors and exhibition designers to produce the finest archival quality photographic printing, mounting and framing.

▼
Please call or write for our free museum package which lists services and prices.

AZO COLOR LABORATORIES, INC
149 Madison Avenue, New York, N.Y. 10016 (212) 982-6610

Full cooked ready to eat
SMOKED TURKEY

OZARK COUNTRY SMOKED		**OZARK COUNTRY CURED**
10 to 12 lb.	Young Whole Turkey	$29.95
4 to 5½ lb.	Breast of Turkey	$18.95
5½ to 7 lb.	Breast of Turkey	$24.95
6 to 7 lb.	Boned Turkey Ham	$20.95
Special Gift Packaging		$ 5.00

(Includes delivery continental U.S.A.)

BRONZWOOD Turkey is made moist and tender by special curing, Hickory wood smoking, and can be served for Breakfast, Lunch, Hors d'oeuvres, and Dinner. Free recipe collection.
Call/Mail: M C VISA or Money Order in U S. Fund to:

BRONZWOOD TURKEY FARM EST. 1938
(West) 314-377-4433 (East) 609-924-9655
Box G, RFD Stover, Missouri 65078

WILDERNESS TRAVEL

A WORLD OF DISCOVERY
• TIBET • Nepal • China •
• European Walking Tours •
• Andes • Amazon • Galapagos •
• African Wildlife Safaris •
• Galapagos hiking trip led by Tui de Roy Moore •
Expert Leaders *Small Groups*
Write for free illustrated Catalog
WILDERNESS TRAVEL
1760-NJ Solano Avenue, Berkeley, CA 94707
(415) 524-5111

Why Zeiss binoculars?

Zeiss binoculars are manufactured to the highest standards of quality. The best optical glass was used in making them, and all of the lenses and prisms are optical masterpieces. In addition, the utmost care is taken in all other phases of production. Pick up a pair. You will understand why Zeiss is able to give a lifetime guarantee.
Write to the "optics headquarters for the bird-watcher" for literature and discount prices.

BIRDING
P.O. BOX 5-H
AMSTERDAM, N.Y.
12010

Haband's

Flannel Lined Winter Slacks

only
21.95
Buck Winter's Worst and really Enjoy It!
TOUGH GABARDINE BONDED TO WARM FLANNEL!
A Deluxe pair of Slacks!

TESTED! PROVEN 56% WARMER*

than regular cotton flannel AND wool worsted! An entirely new, double-faced self-lined fabric – one side super-tough polyester & cotton gabardine, the other fleecy FORTREL® polyester flannel.

Lighter Weight • Machine Wash & Wear
• *Sharp knife-like crease* •
No bumps, sags, or bags • Great Value!

In Navy or Tan, but you'll want both! Designed for bitter outdoor weather, there's no law that says you can't wear them indoors too, especially during a fuel crisis!

Order now! At Haband's inflation-fighting low price, combined with the wintry forecast we know these slacks won't be here for long!

*Test results available on request from Guilford Mills, New York, N.Y.

FLANNEL LINED WINTER SLACKS 21.95 2 for 43.25

HABAND COMPANY, Executive Division
265 N. 9th St., Paterson, N.J. 07530

Please send _____ pairs.
I enclose $_______ plus $1.50 toward shipping.

Waist: 30-32-34-35-36-37-38-39-40-41-42-43-44-46*-48*-50*-52*-54*.
**These sizes add $2 per pair.*
Inseams: Short (27-28), Med. (29-30), Long (31-32), X-Long (33-34)

Guarantee: *If on receipt I don't want to wear them, I may return the slacks within 30 days for full refund of my remittance.*

751-03A

Color 03A	Waist	Inseam
NAVY A		
TAN B		

Or Charge to:
VISA Acct #__________
MasterCharge Exp.Date __/__/__

Name__________
Street__________ Apt. #______
City__________
State__________ Zip__________

HABAND COMPANY

Additional Reading

Hawaii: A Natural History, by S.J. Carlquist (Garden City: Doubleday/Natural History Press, 1970), covers the islands' geology, climate, native flora, and fauna above the shoreline. It discusses Hawaiian biological phenomena (dispersal to the islands, problems of island existence, adaptive radiation and unique adaptations, arborescence, flightlessness in insects and birds, loss of dispersibility in plants, and loss of competitiveness and other changes); special Hawaiian groups (land shells, honeycreepers and other birds, lobelioids, and silverswords and their relatives); and biological regions of the main islands (the coast, wet and dry forests, epiphytic vegetation, bogs, the alpine zone, and the Northwestern Hawaiian Islands). See also Carlquist's *Island Biology* (New York: Columbia University Press, 1974). Research botanist C.R. Gunn and free-lance writer and biologist J.V. Dennis collaborated on *World Guide to Tropical Drift Seeds and Fruits* (New York: Quadrangle/New York Times Books, 1976). After a brief introduction to plant dispersal, this book discusses buoyancy and the ability of seeds to float long distances in seawater; line drawings help identify them and information is provided on how and where to collect them. Much more technical is L. van der Pijl's *Principles of Dispersal in Higher Plants* (New York: Springer-Verlag, 1969). This monograph considers the ways in which higher plants use their dispersal organs to relocate and establish new generations, emphasizing two different aspects: actual dispersal as studied in the field and the structural basis needed to attain this dispersal. Difficult to find but valuable primary scholarly references are H.B. Guppy's *Observations of a Naturalist in the Pacific* (London: Macmillan and Co., 1903–06) and H.N. Ridley's *The Dispersal of Plants Throughout the World* (Ashford, England: L. Reeve and Co., 1930). Readers interested in the plant life of the Hawaiian Islands may write to the Hawaiian Botanical Society, Department of Botany, University of Hawaii, 3190 Maile Way, Honolulu, HI 96822.

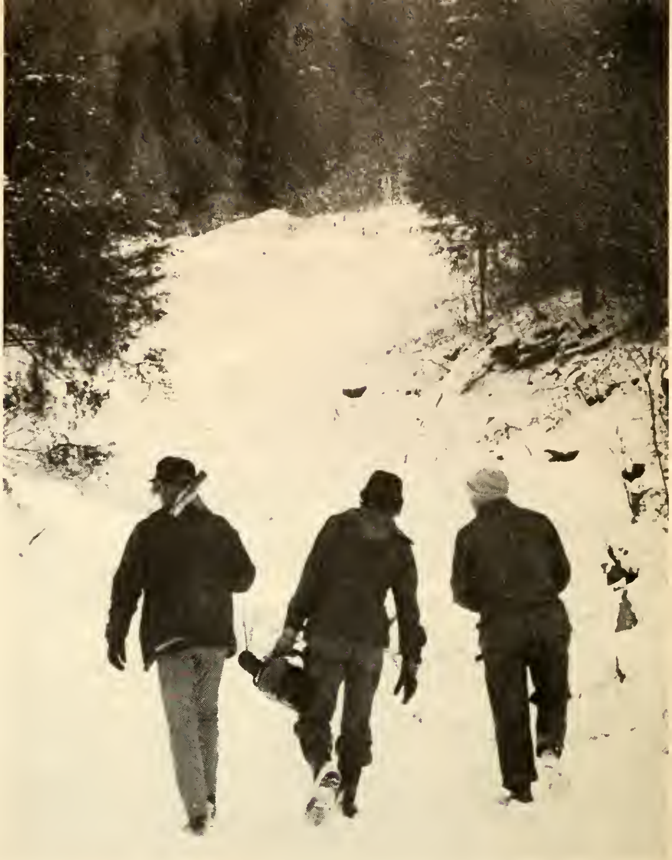
In the past two decades or so, archeologists and anthropologists have succeeded in reconstructing a picture of ancient Polynesian culture. *The Prehistory of Polynesia*, a compilation of fifteen articles edited by J.D. Jennings (Cambridge: Harvard University Press, 1979), tells the story of Polynesia from its origins near the eastern tip of New Guinea to the first encounter with Europeans; a chapter is devoted to the settlement of Hawaii. See also S.L. Olson and H.F. James's article "Fossil Birds from the Hawaiian Islands: Evidence for Wholesale Extinction by Man Before Western Contact" (*Science*, vol. 217, pp. 633–35), which discusses the discovery of tens of thousands of fossil bird bones in the Hawaiian Islands as well as the destructive impact of Polynesian settlement on Hawaii.

Hawaiian Birdlife, by A.J. Berger (Honolulu: University of Hawaii Press, 1981), gives a readable summary of knowledge about Hawaii's birds. It includes a short introductory chapter on Hawaiian natural history ("A Bird's-eye View") and chapters on indigenous, endemic, and introduced birds. I.A.E. Atkinson's "A Reassessment of Factors, Particularly *Rattus rattus* L., That Influenced the Decline of Endemic Forest Birds in the Hawaiian Islands" (*Pacific Science*, vol. 31, pp. 109–33) summarizes extinctions that have occurred since the arrival of Westerners and discusses the various causes, especially introduced predators. For more up-to-date information, subscribe to *The 'Elepaio*, the monthly journal of the Hawaiian Audubon Society, P.O. Box 22832, Honolulu, HI 96822. The Nature Conservancy, 1026 Nuuanu Avenue, Honolulu, HI 96817, publishes a quarterly newsletter detailing its projects in Hawaii.

The best data on the biology of monk seals is buried in contracted reports and agency literature not readily accessible to the general public. Some of the best published sources of information on the monk seal are: K.W. Kenyon's "No Man is Benign: The Endangered Monk Seal" (*Oceans*, May 1980, pp. 48–54) and "Man versus the Monk Seal" (*Journal of Mammalogy*, vol. 53, pp. 687–96); G.C. Whittow's "Tropical Seals" (*Sea Frontiers*, vol. 17, pp. 285–87); W.O. Wirtz III's "Reproduction, Growth and Development, and Juvenile Mortality in the Hawaiian Monk Seal" (*Journal of Mammalogy*, vol. 49, pp. 229–38); C.A. Repenning and C.E. Ray's "The Origin of the Hawaiian Monk Seal" (*Proceedings of the Biological Society of Washington*, vol. 89, pp. 667–88); and P.Q. Tomich's "Mammals in Hawaii: A Synopsis and Annotated Bibliography" (*B.P. Bishop Museum Special Publication* 57, pp. 1–238). A number of articles and books describe the Northwestern Hawaiian Islands, habitat of the Hawaiian monk seal; two of the best and most easily available are J.L. Eliot's "Hawaii's Far-flung Paradise" (*National Geographic*, May 1978, pp. 670–91) and R. Wallace's *Hawaii: The American Wilderness* (New York: Time-Life Books, 1973). As it may be some time before results of field studies conducted during the last four or five years are published, seriously interested readers may wish to write to the National Marine Fisheries Service for copies of in-house reports pertaining to the monk seal. Data from the most intensive field studies, by B. and P. Johnson, have been gathered in NMFS reports. One particularly good source of information on the seal is "Draft EIS for Proposed Designation of Critical Habitat for the Hawaiian Monk Seal in the Northwestern Hawaiian Islands," distributed by the service in February 1980. The "Monk Seal Recovery Plan," a document incorporating the most recent studies by NMFS and U.S. Fish and Wildlife Service biologists, will soon be available from NMFS.

M. Williamson's *Island Populations* (Oxford: Oxford University Press, 1981) gives a solid introduction to the geologic history of the islands and has a long, detailed chapter on the Hawaiian Drosophilidae. E.A. Kay edited *Natural History of the Hawaiian Islands* (Honolulu: University of Hawaii Press, 1972), a large paperback with twenty-seven articles on Hawaiian volcanoes, fish, flora, birds, and *Drosophila*. It has sections on the history of the Pacific Basin and Hawaii; the land, the sea, the biota; Hawaiian-style insular evolution; and Hawaiian natural history, past and present. One section includes articles by noted island biologists E.C. Zimmerman (on adaptive radiation in Hawaii with reference to insects) and H.L. Carson (on *Drosophila*). *Island Ecosystems*, edited by D. Mueller-Dombois, K.W. Bridges, and H.L. Carson (Stroudsburg: Dowden, Hutchinson and Ross, Inc., 1981), brings together a series of papers discussing many of the topics covered in this issue, including the genetics of Hawaiian insects. For a better understanding of stream and river ecosystems, see *The Ecology of Running Waters*, by H.B.N. Hynes (Toronto: University of Toronto Press, 1970). This is an excellent general text with an extensive bibliography.

Rita Campon



AT JACK DANIEL'S DISTILLERY we never have to go too far to find our Christmas tree. The woods around here are full of them. So getting a good one is never a problem. We hope you won't have to go to too much trouble getting ready for the holidays either. So you can sit back and enjoy this happiest of all seasons with your family and good friends.

CHARCOAL
MELLOWED
DROP
BY DROP

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery
Lem Motlow, Prop., Inc., Lynchburg (Pop. 361), Tennessee 37352
Placed in the National Register of Historic Places by the United States Government.

JACK DANIEL'S
Old No. 7
Tennessee
WHISKEY

LET US NOT GO OVER THE OLD GROUND, LET US RATHER PREPARE FOR WHAT IS TO COME.
—MARCUS TULLIUS CICERO

OMNI MAGAZINE

BRINGS YOU CLOSE-UPS OF THE FUTURE AT A SPECIAL, MONEY-SAVING SUBSCRIPTION PRICE.

What's ahead in the 1980's? The '90's? The year 2000?

What scientific breakthroughs are happening now, or anticipated, in medicine? Space travel? Solar energy? Electronics?

You can be sure of this: The future will be different, fast-changing, and full of opportunities for those who plan for it.

OMNI is the magazine of the future. It is the leading publication and pioneer in reporting the new frontiers of science. Every month, there are new explorations to take. Voyages to the far reaches of the solar system and beyond. Journeys through the intricate universe of the human mind. Grand tours of the latest findings in oceanography, geology, chemistry, physics and much more.

OMNI also reports on new happenings in medical research. Looks soberly at UFO reports. Interviews our greatest scientists and philosophers. Entertains with the finest in science fiction.

Award-winning writing, breathtaking pictorials. In OMNI, you'll find quality and imagination. We publish and interview such creative giants as James Michener, Jonas Salk, Ray Bradbury, Isaac Asimov, Buckminster Fuller, Arthur C. Clarke. And each issue features some of the most spectacular art and photography found in any publication. It's the magazine for people who want to know more about now and what is to come. You'll get your money's worth many times over in information and entertainment.

Subscribe now for a 20% savings. A one-year's subscription to OMNI is only $23.95. That's 20% off the cover price! Just fill out and mail the coupon or postage-paid order card right away. With OMNI, you'll be ready for both today and tomorrow!

OMNI
THE ORIGINAL

OMNI P. O. BOX 5700 BERGENFIELD, N.J. 07621 MFMA7

YES. Please send me OMNI for one year (12 issues) at $23.95.

☐ Payment enclosed ☐ Bill Me ☐ MasterCard ☐ VISA

Acct. # ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ Expire date: ____

Interbank # for MasterCard ☐☐☐☐ Signature: ____

Name ____

Address ____

City & State ____ Zip ____

Please print. Rates for U.S. addresses only. Canada and elsewhere: $34, one year. Payment must be made in U.S. currency. Allow 6 to 8 weeks for delivery of first issue.

SUBSCRIBE NOW TO OMNI
THE MAGAZINE THAT LOOKS INTO THE FUTURE. SAVE 20% OFF THE COVER PRICE!

OMNI
P. O. BOX 5700, BERGENFIELD, N.J. 07621

YES. Please send me OMNI for one year (12 issues) at $23.95.

☐ Payment enclosed ☐ Bill Me ☐ MasterCard ☐ VISA

Acct. # ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Interbank # for MasterCard ☐☐☐☐ Expire date: ____

Signature: ____

Name ____

Address ____

City & State ____ Zip ____

Please print clearly. Rates for U.S. addresses only. Canada and elsewhere: $34 for one year. Payment must be made in U.S. currency. Please allow 6 to 8 weeks for delivery of first issue. MGNA4

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 52 BERGENFIELD, N.J. 07621

POSTAGE WILL BE PAID BY ADDRESSEE

OMNI
P. O. BOX 5700
BERGENFIELD, N.J. 07621

A Garden of Earthy Delights

While no solution to world hunger, "boutique agriculture" gives some people a taste of quality

by Raymond Sokolov

Age creeping into one's marrow turns the mind, mine anyway, to the heavy sensual smell of green tomatoes ripening slowly, slowly along the fence on summer's vines. The hope of sinking one's teeth into a thin-walled, home-grown tomato in the still heat of late August spurs the juices of an old gaffer trying to weather the cold months with as much grace as he can muster. Tomato nostalgia lingers on until spring and the hunger for a tomato that won't bounce pushes even the most experienced gardener into overplanting, so that by Labor Day he finds himself toting bags of surplus tomatoes into town to foist on friends and colleagues who themselves have for the moment too many tomatoes already plucked from their own fire-escape plantings or stake-picketed yards. For a delirious two or three weeks, we drown in tomatoes, as we were, earlier in the summer, drowning in snap beans, and still earlier in peas.

I take no credit for this seasonal superabundance that fills the refrigerator with galumphing bags of insistent, perishing fruits and vegetables. My wife has blossomed into a modern Pomona, tilling and weeding, fretting over rabbits and Japanese beetles, as she coaxes bounty from our garden in New York's Hudson Valley. That one city-bred woman can harvest so much food from so small a plot repeats the oldest lesson in agriculture. It is possible to grow enough food, with part-time labor in a short span of time, to feed oneself and one's family for the rest of the year. From this realization sprang the original kitchen garden as well as the science of putting food by, with salt or by drying or canning or freezing.

Success on this homely scale will suggest to the innately ambitious that with slightly greater effort next time, they might produce enough to sell to others. Even a kitchen garden can produce cash crops.

Buy a motorized tiller. Expand the plot to an acre. Open a farm stand. And before you know it your garden has grown into a truck farm. It still takes major investment and a coldblooded attitude toward the inevitably declining quality of your produce to take the next step in the process and launch a full-scale, modern vegetable operation, complete with hired pickers and high-priced machinery, herbicides and fungicides, and big fields planted in one crop as far as the eye can see. But this is exactly the history of California's Central Valley, that monumentally fecund factory of fruits and vegetables, that hot oasis consecrated to monocropping megalomania.

It was recently my pleasure to visit the Central Valley as the guest of a local landowner and gastronome named John Hudspeth. We drove out from Berkeley on the eastern shore of San Francisco Bay to Hudspeth's spread near Sacramento. Leaving the interstate, we sped along back roads past infinitely receding peach orchards carpeted with fallen fruit, past walnut groves, past tomato fields and big vats of harvested tomatoes (40,000 pounds of tomatoes per vat), ready to be trucked away to satisfy America's amazingly undiscriminating hunger for tomatoes.

Hudspeth, too, produces fruits and vegetables on his land. But he hears a different drummer. He is a worshiper at the shrine of Epicurus, and he has started a small but high-quality four-acre truck garden.

Hudspeth himself is no gardener. He hired a professional horticulturist, Karen Montrose, to work his land for him. But he is the key figure in the operation, having conceived and organized it and kept it on a financially even keel, as the corn and melons and herbs began to sprout and flourish on a small piece of the 500-acre family ranch that his father had once devoted to horses.

Food-mad Hudspeth is a refugee from a Bible-thumping lumbering town in Oregon. First he fled to Portland, where he took cooking classes with James Beard, himself a son of the Northwest coast. Mr. Beard's assistant was Marion Cunningham, who befriended Hudspeth and introduced him to the sophisticated food world being born near her home, down south, in and around Berkeley and other parts of the East Bay. In particular, Marion Cunningham took John Hudspeth to a small Berkeley restaurant called Chez Panisse, where he subsequently dined every night for a year.

Among its virtues, this brilliantly chaotic Californian-French restaurant can claim the distinction of being obsessively interested in regional ingredients, from California chestnuts to mushrooms to local caviar. Dozens of friends of Chez Panisse bring in edible exotica from back-

Whole Natural ALMONDS

from . . . Treehouse Farms, Inc.

Give a Special Gift this Holiday Season. The very finest almonds fresh and shelled are shipped directly from our orchards to you. Mail your order along with any special shipping instructions to:

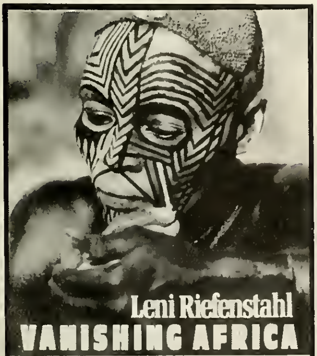
TREEHOUSE FARMS, P. O. Box 168,
Earlimart, CA 93219.

SATISFACTION GUARANTEED.

Check, Money Order, Visa, Master Card

Elegant Foil Lined Gift Box

3-lb. Box $12.00 5-lb. Box $18.50



Leni Riefenstahl, renowned photographer, captures the splendid pageantry of rituals and celebrations so strange and fascinating to the rest of the world. $30.00, now at your bookstore, or use coupon to order.

CROWN PUBLISHERS, Dept. 995
34 Engelhard Ave., Avenel, N.J. 07001

Please send me VANISHING AFRICA. I enclose my check or money order for $30.00 plus $1.70 postage and handling charge. If I wish, I may return the book postpaid within ten days for full refund

Name____________________

Address____________________

City__________ State______ Zip______

N.Y. and N.J. residents, add sales tax.

yard gardens and plots in the Berkeley hinterland. In the season, for example, an old man arrives with twenty-five pounds of blackberries, his body lacerated from the thorns he has braved in his impassioned gathering.

Various gardens have supplied the restaurant over the years, but there was a definite need for another one, close by, to grow perfectly fresh, unusual delicacies in dependable quantity. Hudspeth had access to the family ranch near Sacramento, which is a feasible day trip from Berkeley. Why not garden there?

The only trouble was that Hudspeth didn't know how, nor did he want to tie himself to his land, tending potatoes and peppers, even for Chez Panisse. The solution emerged at a chic west coast fat farm, where the would-be gentleman farmer encountered a serious professional gardener in the energetic person of Karen Montrose, who had moved up from community gardens in San Diego to more rarefied horticulture at the spa. Today, she presides over a flower-dotted, weedless paradise of French-intensive beds—mounded communities of plants that intermix to mutual benefit, some decoying insects from the others, some exploiting land that otherwise would have lain open for infestation by less useful flora. Sunflowers busy the birds. Nasturtiums collect bugs and marigolds repel them in this sunlit dream of organic gardening.

While for hundreds of hectares in any direction, big-time agriculture forces mediocrity from the soil with chemicals and machines, hand labor and intelligent planning on the Hudspeth spread entice a cornucopia from a relatively small patch of ground.

There are wee yellow Finnish potatoes no bigger than your finger, three crops a year of them, all spawned from one Ziploc baggieful sent as a gift by friends from a self-sufficient farm in Oregon. There is hybrid sweet corn, fabulous to eat raw right off the stalk. Little French melons, *melons du Midi*, ripen not far from miniature yellow tomatoes, leeks, red lettuce, and red and green onions; Sweet 100 cherry tomatoes cluster like grapes on trellised vines. Twenty-one kinds of herbs and squash and various hot and not so hot peppers and chilies and on and on. . . .

Similar gardens have sprung up in other places around the country, catering to especially demanding restaurants and private customers who have recently turned eager for such arcana as dwarf white eggplants. Greenmarkets, about which I will have more to say in the future, have also promoted small-scale truck farming with an emphasis on diversity of crops.

It is risky to speak about trends. Elite gardening à la Hudspeth is the epitome of boutique agriculture and can hardly be taken as a sign of an important shift in the macroeconomic subsoil of American farming. On the other hand, something is happening out there that offers an increasingly broad and ever more easily available alternative to the witless uniformity of corporate farming.

Boutique gardening may be no answer to the problem of feeding the world's billions of hungry mouths, but it is a luxury that harms no one and that can be defended on the same grounds as any other high art. It gives us a taste of quality, and it shows what wonders skilled and inventive human beings can create if you give them a little time and the proper resources.

On his way out of the garden, John Hudspeth stopped to run his hand through a box of round, brown seeds. Karen Montrose and her crew had harvested them from a bed of *cilantro*, the umbelliferous green herb so indispensable to Hispanic and Chinese cooking. It looks something like broadleaf parsley, but its aroma is powerful and unique. The English common name of the plant is coriander, and those seeds were fresh examples of the same coriander seed sold commercially as a spice. I bit into one and understood for the first time why the spice, which tastes so dusty and muted in its tired, bottled version, had long ago captured the imaginations of spice-wise cooks in Indian villages.

Hudspeth looked pleased. He left Karen Montrose to cultivate his garden and drove home in his red Porsche to enjoy yet another meal at Chez Panisse.

Raymond Sokolov's new book, Fading Feast *(Farrar, Straus and Giroux), is a collection of food columns that first appeared in* Natural History.

John Hudspeth's Corn Pancake

4 ears corn
2 tablespoons butter

1. Shuck the corn.
2. Cut kernels off the cobs with a knife.
3. Squeeze out the milk from the kernels by pressing with a wooden spoon in a sieve. Save the milk for soup.
4. Heat the butter in a heavy skillet until the foam subsides. Then sauté the kernels very slowly, until the corn browns and forms a sort of pancake. It should stick against the pan just long enough to make a nice crust. Then turn the pancake and repeat the process.

Yield: 4 servings

ECUATORIANA

ECUATORIANA

All of South America. The easy way.

We make the business and vacation opportunities of South America easy to reach. And easy to enjoy. And we do it by giving you much, much more than a confirmed seat on a jet going south.

We've programmed our experience into the unique Ecuatronix computer complex. It is the information center that books and confirms the details of your travels all over the Southern Hemisphere. Not only on Ecuatoriana but on connecting local flights, land transportation, car rentals and accommodations if you wish, as well. So you know your travels in South America will be as smooth and comfortable as your flight.

On board, you'll be offered gourmet dining, in-flight entertainment and the prompt, professional attention of some of the most experienced flight attendants in all commercial aviation.

We bring you to the destinations direct or with easy connections from New York, Los Angeles and Miami.

Flying to South America has never been easier for you, your family and your company.

Call toll-free for information and reservations:
800-ECUADOR (800-328-2367).
In Miami, (305) 592-0200. In Canada, 800-268-7537.

ECUATORIANA
the airline of all the Americas®

80 years went into this Century.

1983 Buick Century.

That's how long Buick has been carrying on a love affair with the automobile. A devotion to bringing you comfortable, prestigious, quality cars. And that, of course, is exactly what Buicks have been down through the years.

Right down to today's state-of-the-art Buick Century. With its pleasing and efficient form. And its eminently luxurious passenger environment.

Among Century's impressive engineering credentials: front-wheel drive and a highly efficient 2.5 liter four-cylinder powerplant (see EPA mileage estimates below). Also available are V-6 gasoline and V-6 diesel engines.

EST. HWY.	EPA EST. MPG
39	24

The fact that 80 years went into this Century is surely reason enough to put yourself into one. You can do that at your Buick dealer's today. Oh, and before you turn the key, buckle up.

Use estimated MPG for comparison. Your mileage may differ depending on speed, distance, weather. Actual highway mileage lower. Some Buicks are equipped with engines produced by other GM divisions, subsidiaries, or affiliated companies worldwide. See your Buick dealer for details.

Official Car of the XXIIIrd Olympiad
Los Angeles 1984

BUICK

Wouldn't you really rather have a Buick?